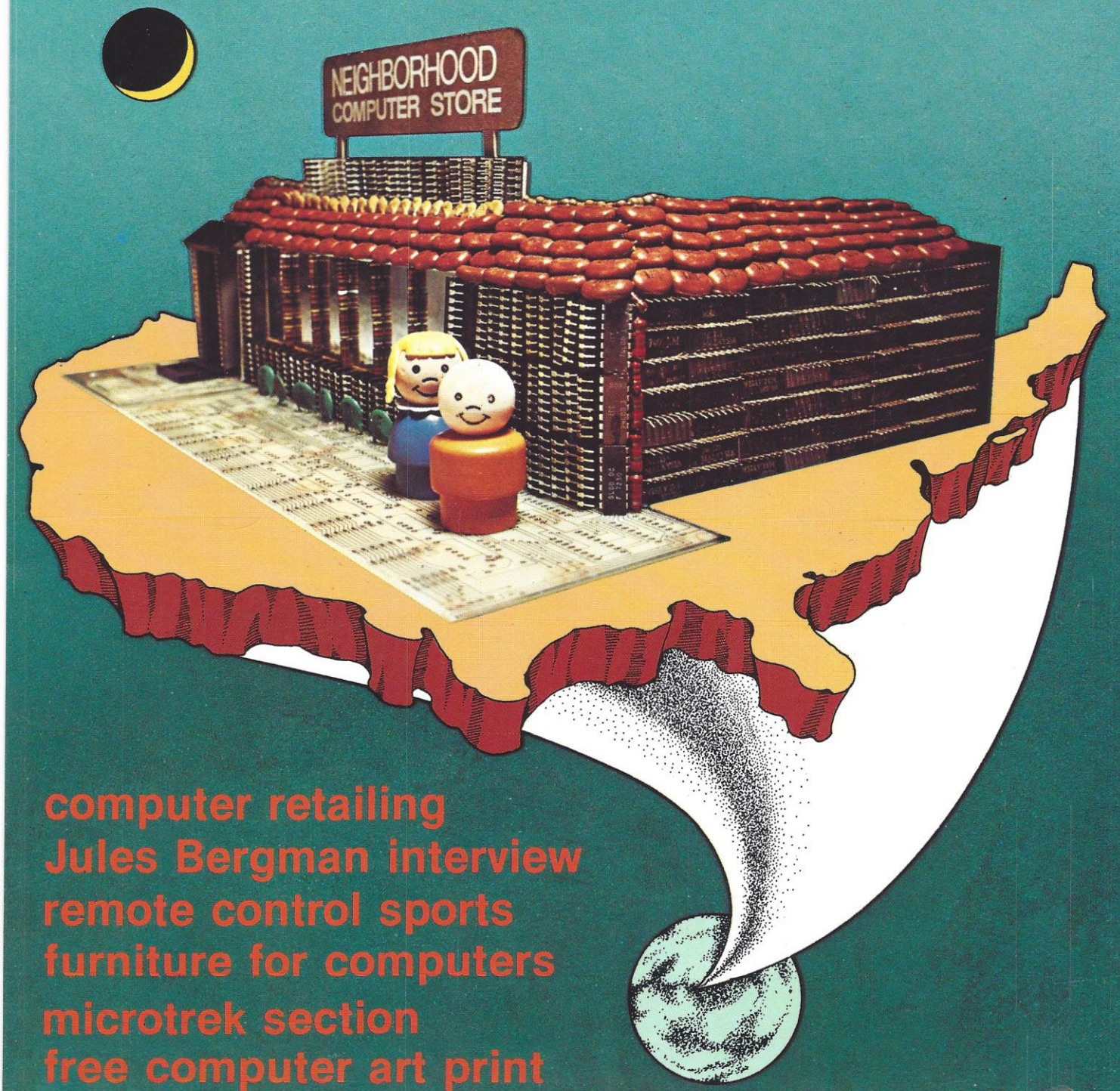
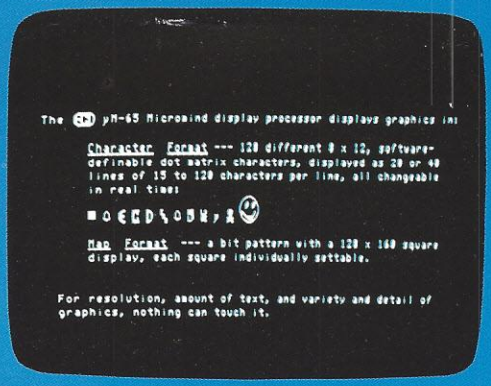
$2.00

Personal Computing

MARCH/APRIL, 1977



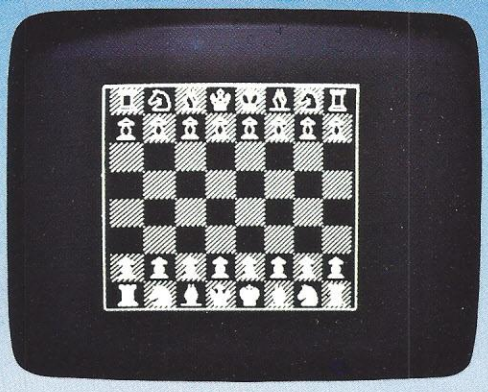
computer retailing
Jules Bergman interview
remote control sports
furniture for computers
microtrek section
free computer art print



Key Into Maxi-Power @ Micro-Price

Micromind is an incredibly flexible, complete and expandable, hardware/software, general purpose computer system. You won't outgrow it.

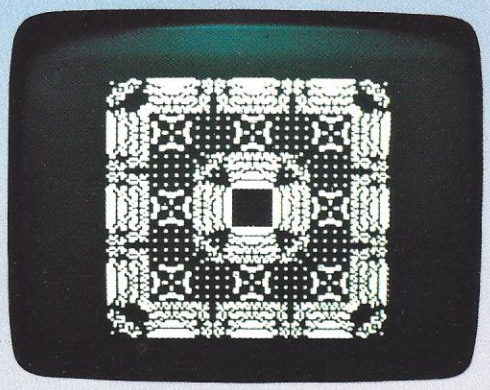
Hardware includes an 80 key, software-definable keyboard, I/O interface board, 6500A-series microprocessor (powerful enough for advanced computing), a high-detail graphics and character display processor, power supply, rf modulator, and connections for up to 4 tape recorders plus TV or monitor. An interconnect bus



permits 15 additional microprocessors, parallel processing and vastly increased computing power.

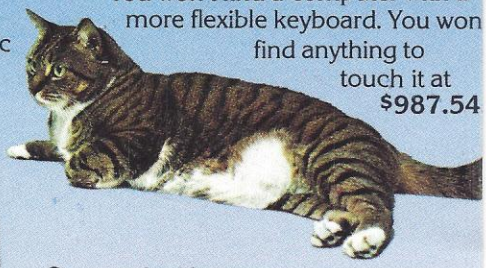
System software—including ECD's own notsoBASIC high level language, on advanced error-correcting tape cassettes—provides a word processing editor, a powerful assembler, a debugger, a file system, graphic routines, and peripheral handlers. We also include dynamic graphic games: Animated Spacewar and Life.

ECD's standard Micromind μM-65 supplies 8K bytes of memory. Additional 32K byte expansion boards and a mappin option give Micromind expandable acces to 64 Megabytes. Utilizing software-controlled I/O channels, Micromind's advanced encoding techniques load data from ordinary tape recorders at 3200 bits per second.



Micromind comes to you ready-to-use, factory assembled and fully tested. Among microcomputers, it has the largest memo capacity and the fastest storage. You're looking at the work of the finest display processor on the market. You won't find a microcomputer with a more powerful CP

You won't find a computer with a more flexible keyboard. You won find anything to touch it at **$987.54**



So, quit the kluge scene and key into Micromind. You'll be a main frame performer, with all the comforts of home. We're not fooling...this is the cat's μ!

ECD CORP.
196 Broadway, Cambridge, Mass. 02139
(617) 661-4400

ECD

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Address _____

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☐ Fantastic! Check enclosed: **$987.54.** Shipping paid by ECD
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Signature _____

☐ Send me your brochure.

Meet the most powerful

μC system available for dedicated work.

Yet it's only $595.*

*kit price

Here's the muscle you've been telling us you wanted: a powerful Cromemco microcomputer in a style and price range ideal for your dedicated computer jobs—ideal for industrial, business, instrumentation and similar applications.

It's the new Cromemco Z-2 Computer System. Here's some of what you get in the Z-2 for only $595:

- The industry's fastest μP board (Cromemco's highly regarded 4 MHz, 250-nanosecond cycle time board).
- The power and convenience of the well-known Z-80 μP.
- A power supply you won't believe (+8V @ 30A, +18V and −18V @ 15A — ample power for additional peripherals such as floppy disk drives).
- A full-length *shielded* motherboard with 21 card slots.
- Power-on-jump circuitry to begin automatic program execution when power is turned on.
- S-100 bus.
- Standard rack-mount style construction.
- All-metal chassis and dust case.
- 110- or 220-volt operation.

DEDICATED APPLICATIONS

The new Z-2 is specifically designed as a powerful but economical dedicated computer for systems work. Notice that the front panel is entirely free of controls or switches of any kind. That makes the Z-2 virtually tamper-proof. No accidental program changes or surprise memory erasures.

FASTEST, MOST POWERFUL μC

Cromemco's microcomputers are the fastest and most powerful available. They use the Z-80 microprocessor which is widely regarded as the standard of the future. So you're in the technical fore with the Z-2.

BROAD SOFTWARE/PERIPHERALS SUPPORT

Since the Z-2 uses the Z-80, your present 8080 software can be used with the Z-2. Also, Cromemco offers broad software support including a monitor, assembler, and a BASIC interpreter.

The Z-2 uses the S-100 bus which is supported by the peripherals of dozens of manufacturers. Naturally, all Cromemco peripherals such as our 7-channel A/D and D/A converter, our well-known BYTESAVER with its built-in PROM programmer, our color graphics interface, etc., will also plug into the S-100 bus.

LOW, LOW PRICE

You'll be impressed with the Z-2's low price, technical excellence and quality. So see it right away at your computer store—or order directly from the factory.

Z-2 COMPUTER SYSTEM KIT (MODEL Z-2K) (includes 4 MHz μP card, full-length 21-card-slot motherboard, power supply, one card socket and card-guide set, and front panel; for rack mounting) . . . . . $595.

Z-2 COMPUTER SYSTEM ASSEMBLED (MODEL Z-2W) (includes the above as well as all 21 sockets and card guides and a cooling fan; for rack mounting) . . . $995.

Shown with optional bench cabinet

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CIRCLE 4

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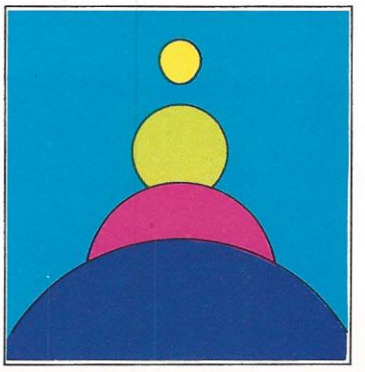
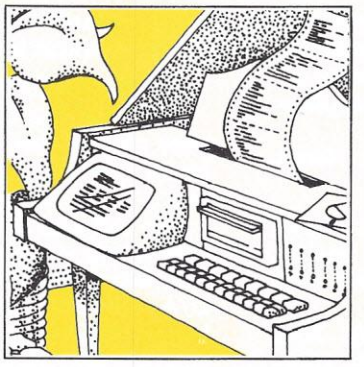


Jules Bergman tells of the computer's impact on moon shots and news.

49

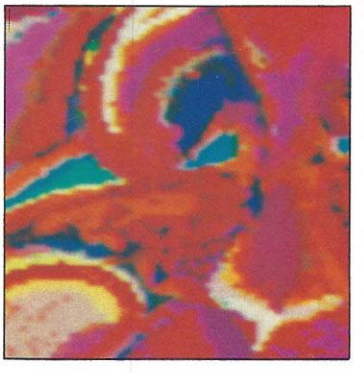


Handsome furniture lets you put your computer in the livingroom.

98

Remote-control games are envisioned as a national sport.

140



Hands, faces and abstract designs characterize Duane Palyka's poster on our back gatefold.

SUBSCRIPTION POLICY

Subscription rates (annual): U.S., $8; Mexico and Canada, $14 surface mail and $18 airmail; All other countries, $26 airmail. Single copies and back issues (as available): $2 in U.S.; $4 in Canada and Mexico; $5 in all other countries. Send subscription orders and changes of address to: Circulation, Personal Computing, 167 Corey Road, Brookline, MA 02146.

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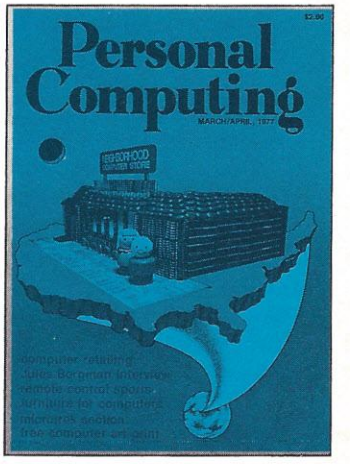

Tom Antreasan's version of a neighborhood computer store constructed from electronic components. Photograph by Stephen Marks. Cover illustration and design by Jane Higgins.

All editorial correspondence should be addressed to PERSONAL COMPUTING, 401 Louisiana S.E., Alburquerque, NM 87108.

We welcome submission of manuscripts for publication and pay competitive rates for material accepted. Authors should study the magazine for content and style to avoid sending inappropriate material at expense in time and postage.

Always include a stamped, self-addressed envelope if you want material returned. PERSONAL COMPUTING takes no responsibility for the safekeeping of materials not specifically solicited but attempts to respond promptly to submissions.

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Letters

Dear Editor

Congratulations on an excellent premier issue. Practically everything I know about computers came from your first issue ... How about a glossary – some terms each issue? I couldn't purchase computer products now if I wanted to, because I can't understand a spec sheet!

On page 24 (Step 4), "Do you want ASCII or Baudot interfacing?" What? To date, my answer has to be "Sure!"

I don't think there are any computer stores around here – and the club member listed has his phone disconnected (Coral Springs). I don't expect much help from our library so it would also be nice to have a section devoted to literature review with source and price and shipping cost if applicable.

I think you did a fine job on your first issue. I need your next 10 issues now ...

L. Grow
Pompano Beach, Fla.

Thanks. Yes, the glossary is a desirable feature, and we plan in the future to run a glossary of the technical terminology used in each issue, taking our definitions from a book you might like to obtain: Microcomputer Dictionary and Guide *by Charles J. Sippl and David A. Kidd, Matrix Publishers Inc., Champaign, Ill. 61820. 680 pages of very useful stuff. And our stores listing in this issue indicates Micro Computer System Sales and Service is in Pompano Beach.*

Dear Editor

Congratulations on your first issue. It wasn't quite as good as I had expected, but still acceptable.

I think interviews are a great idea; but, I don't think you could have picked a worse candidate for your premier issue. I found Mr. Parker most offensive. As for me, I intend to use to my advantage, any way I can, all the artificial intelligence my computer can give me, whether the other side has a computer or not.

Kenneth A. Hesey
Arlington, Va.

Dear P.C.

I just wanted to be one of the first people to congratulate you on the magnificent job you did on the premier issue. As of now I think I've read the issue three times over, loving it better each time. The part I liked the best though was the Lemonade Computer Service Company since putting my computer to work making me money is one of the reasons why I intend to get one. (The other reason is so I can play Star Trek!) I'd like to see the L.C.S.C. emphasized in the future along with reader participation in coming up with new ideas. Keep on computing!

Michael P. Shipley
Riverdale, Md.

Dear Editor

... Pretty magazine. Keep it up ...

I am at step 2 in Henry Gilroy's article – reading everything in sight about microcomputers. I am looking for the system with the best performance to cost ratio. I also want an economical assembled system. I have visions of wiping out enough components trying to assemble a kit that I use up the price difference between kit and assembled versions, or of thousands of cold solder joints staring up at me. That sort of thing. Mainly I am steeling myself for a big cash outlay.

William R. Hamblen
Nashville, Tenn.

Cheer up. A good many rank beginners have managed to assemble kits with a little help, of which you should be able to find some in friendly Nashville. Note also that some systems compromising between kits and assemblies are showing up in the market.

Dear P.C.

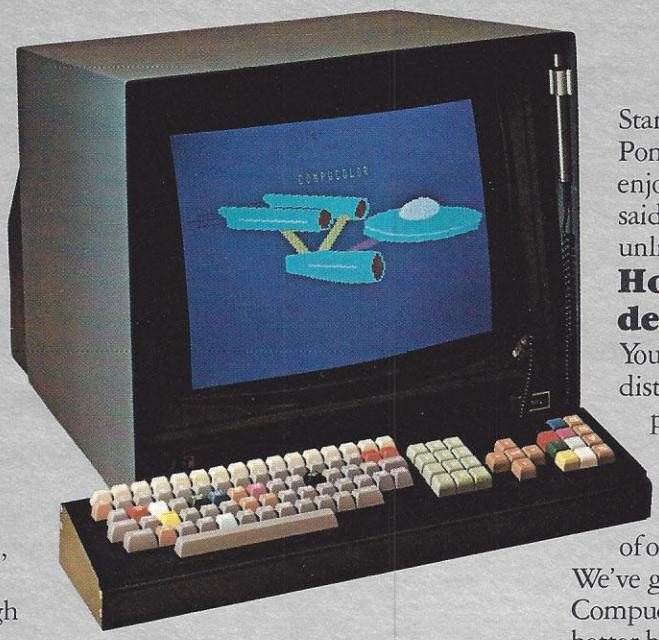
I found the first issue very interesting, especially to someone starting in computing. I am interested for hobby and business. Keep up the good work. I obtained the first copy at the Electronica 76 show in München.

Rudolf Birkenkopf
West Germany

The Compucolor 8001 System.

It's A Stand Alone Micro Computer With Color Input/Output Capabilities All In One Package. For Only $2995.

If you're looking for an input device, an output device and a micro computer all in one package, you've found it. The Compucolor 8001. It's here now, in color, on sale for only $2995.



We gave it a memory of its own.

And Floppy Tape Memory is just for starters. Look at these other features. BASIC Language, 8080 CPU, 8 color CRT Terminal, 8K RAM Workspace, Selectable Baud Rate to 9600, Two RS 232 I/O's, Keyboard with 16 Function Keys, Background Color, Lower Case ASCII Characters, Roll, Insert/Delete, 48 Line X 80 Characters/Line, 2X Character Height, thorough operating instructions and a Graphics Mode with 160 X 192 Elements. And our unique Nine Sector Convergence System guarantees you quick set-up, exceptional stability and outstanding color registration in three to five minutes. If you can find a better buy in a color Intelligent CRT and Micro Computer system, let us know. We think we've got the best of both worlds at the best price going. And we want to prove it to you.

Name your game.

After all, you'll have your very own personal computer right at your fingertips. For the most simple or complex tasks. Or just plain fun. The applications are unlimited. Color graphics and computations, check book balancing, educational instruction, tutoring and a unique variety of computer games. Like Star Trek and Hangman and Pong. You can even sit back and enjoy a game of chess. Like we said, the applications are unlimited.

How about a little demonstration?

You'll find a list of our distributors at the bottom of the page. So drop by and ask for a demonstration. Get some answers to your questions. And if you aren't near one of our distributors, give us a call. We've got the answers. The Compucolor 8001. You won't find a better buy in a color CRT Terminal and Micro Computer.

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Letters

PERSONAL COMPUTING *is receiving remarkable response on the reader service cards inserted in the January/February issue. Most contain comments, of which a few follow.*

Informative articles, quality magazine, would like to read longer interview with Donn B. Parker.

Michael J. Kershaw
Roseville, Mich.

Read it cover-to-cover, including the ads! Informative, fascinating and well-written. "Lemonade" was a bit weak.

Tony Richards

Computers are for all people! Thanx for not leaving us novices behind!

Lester P. Sebay
Vallejo, Calif.

The articles were simple and interesting enough for anyone to enjoy regardless of background. Looking forward to future issues.

Paul Whittington
Chicago, Ill.

First Class! Keep it going!

C.B. Boenning
Cincinnati, Ohio

Excellent

Dr. David R. Beam
Alexandria, Va.

Great magazine! How about a vector graphics project or two. *Please.*

Scott O'Steen
Rocky Ford, Colo.

Excellent. Especially like the user vs. electronics orientation.

Terrence C. Watson
Seattle, Wash.

Too many "feature" articles, not enough technical ones. How about some articles on elementary electronics for the neophyte kit-builder?

Jon Anderson Hall
Hartford, Conn.

Excellent. More on Microprocessor Basics, please. When is APL coming?

William Bullard
Southfield, Mich.

It's in the works. We'll get Allen and Gates to comment.

Absolutely excellent. I'm reading every word with glee, including the advertisements. It's like finding the proverbial "pony in the pile." Right on!

D. F. Wallace
Lanham, Md.

Absolutely GREAT. Nothing on market compares with it. Keep it up.

M. Varey
Winnipeg, Manitoba

Fantastic!! Read it cover to cover. I absolutely must have my own personal computer! Please send all requested info Hurry!!!

John T. Urbano
West Trenton, N.J.

One of the best and most enjoyable publications I have ever read (No jive!) Keep it up and thanks to the staff for their efforts.

R. Riback
Chicago, Ill.

GREAT.

Ralph Teutsch
Chapel Hill, N.C.

Continue to keep in mind the rank beginner!

John Kullberg
Fresno, Calif.

Great premier issue! Keep up the good work.

D. Chris Rethemeyer
Columbia, Mo.

Great! But how about bringing a computer show to the South?

David Boozer
Winter Haven, Fla.

Outstanding. Let's see more software listings.

LCDR Carol G. Strey
Alexandria, Va.

The first issue appears to be the magazine I have been looking for. I read every word before it was put down.

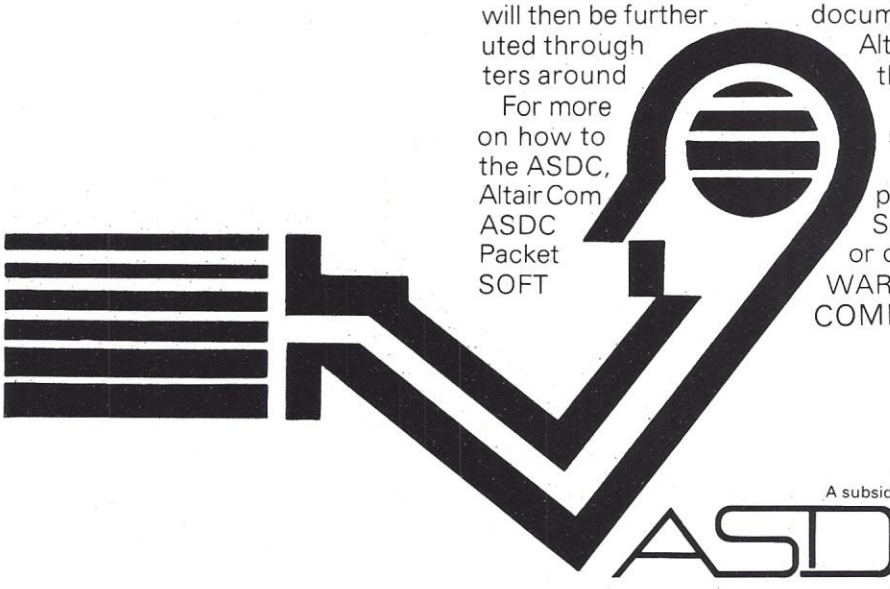
Marvin F. Roberts
Topeka, Kansas

Have you written Software for your Altair™ Computer?

The Altair 8800 computer was the first micro produced for the general public and remains number one in sales, with more than 8,000 mainframes in the field. The wide acceptance of the Altair computer and its rapid adaptation to many diversified applications has truly turned the dream of the affordable computer into a reality.

Yet the machine itself, remarkable as it is, represents only the beginning. The right Software, tailored to meet a user's specific requirements, is a vital part of any computer system. MITS wants to insure that Altair users everywhere have the best applications software available today and in the future. For this reason, a new MITS subsidiary, the ALTAIR SOFTWARE DISTRIBUTION COMPANY, has been formed. Its purpose: to acquire the highest quality software possible and distribute it nationally through Altair Computer Centers.

That's where you come in. The ASDC will pay substantial royalties to the originators of all software accepted into the ASDC library. If you have written business, industrial or commercial use software for the Altair 8800, ASDC wants to hear from you. It is the aim of the ASDC to stimulate and reward creativity in producing useful software that makes those dreams of "computers for everyone" come true. The ASDC will select only software that measures up to its high standards for system design, coding and documentation. The software will then be further documented and distributed through Altair Computer Centers around the country. For more information on how to submit software to the ASDC, ask your Local Altair Computer Center for an ASDC Software Submittal Packet or contact the ALTAIR SOFTWARE DISTRIBUTION COMPANY.



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ASDC

ALTAIR SOFTWARE DISTRIBUTION COMPANY

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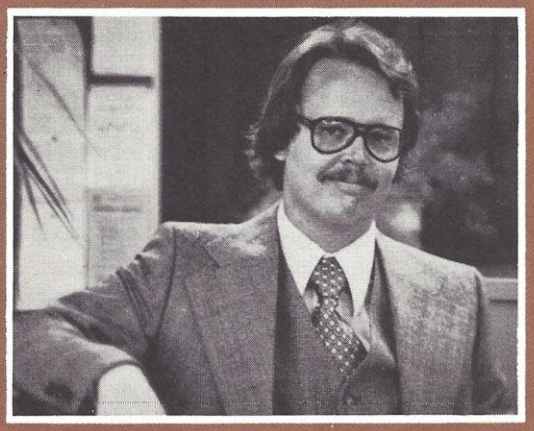
CIRCLE 6

MEMO FROM THE PUBLISHER



David Bunnell

First reactions

Reaction to the first issue of PERSONAL COMPUTING was much better than we had hoped for. If I had sat in a motel room somewhere in Ohio and written the comments on the reader service cards, they couldn't have been more complimentary. We have indulged ourselves and printed many of these in our letters section.

Needless to say, the staff at PERSONAL COMPUTING is very grateful. The viability of our efforts is truly dependent upon our readers. Advertisers provide us with revenue and retail stores, electronic stores and newsstands provide us with distribution; but without the support of our readers none of this would matter.

Welcome Microtrekkers

PERSONAL COMPUTING is proud to announce the acquisition of *Microtrek* magazine, which we will continue to publish as a special section. This will allow us to serve our readers by segregating the more technical articles from general interest articles. Readers who are heavily into computing will find the "meat and potatoes" articles in Microtrek. Readers who are not yet technically knowledgeable need not be embarrassed by articles they cannot understand. They can simply skip this section and go on (although I would suggest that they save Microtrek for future reference).

Wes Schneider, who published the original *Microtrek,* has joined our staff. Wes, a graduate engineer and veteran of the Collins-Rockwell Space Shuttle design group, will continue to edit our Microtrek section.

Industry news

Since we are not a trade publication, we don't normally clutter our pages with industry news. But a recent announcement by Pertec Computer Corp. could have an impact on personal computing that could ultimately affect many of our current and future readers.

PCC has entered into a letter of intent to "acquire" Mits Inc. Mits as many of you know, is currently the largest manufacturer in the personal computing market. Its market share is anywhere from 40% to 60%, depending upon whose figures you trust. An article in *Business Week* last summer referred to Mits as the "IBM of home computers."

A recent survey of 2000 people in California found that

Mits is recognized as a computer company more often than Digital Equipment Corp. or Data General. Rather startling when you consider that Mits this year will gross $6 million to $7 million. DEC would hardly cross the street for that kind of bread.

Still, Mits has not been without its problems. Faced with an expanding market and with the cash flow problems that come with rapid growth, the company had two alternatives: either seek massive outside finance or accept a diminishing share of the market.

Pertec, apparently knowing a good opportunity when it sees one, decided to come to the rescue. The result will make PCC, which already manufactures disk drives, data entry and communications products, CRT terminals, key-to-disk systems, remote batch terminals, etc., one of the most vertically integrated companies in the computer business.

According to Mits president Ed Roberts, Mits will continue to operate as normal. No drastic changes are contemplated in management, personnel or marketing emphasis. Ed will remain as president. The Altair Distribution Co. and the Altair Software Co. will also operate normally.

The one important difference is cash and along with it, increased production capacity. At the time of this writing, Mits occupied 30,000 square feet and was rapidly expanding to 40,000 square feet. PCC is also expected to install automated production equipment at Mits.

Other companies in the personal computing business have often found themselves developing in much the same way as Mits. If this is a trend, it means more computer products at reduced prices will soon be available to the consumer market. However, don't believe the rumors you hear at the local computer store or computer club. Radio Shack (Tandy Corp.) has not purchased IMS Assoc., and no deal is in the works.

SCCS alive and well

I had the privilege of recently attending a regular monthly meeting of the Southern California Computer Society. I'm happy to report that this "international" organization is prospering. The society is participating in our Personal Computing Shows and will hold one of its regular monthly meetings in conjunction with our show in Los Angeles at the International Hyatt House (March 19-20).

It seems to me that the SCCS is in a unique position to influence the future development of personal computing. Most of the members of the society are socially conscious people. They come from a surprisingly broad spectrum of people including lawyers, doctors, engineers, businessmen, teachers, etc. If they manage to avoid too many self-destructive polemics, they could be a force of good in the personal computing community.

Who's on first?

The personal computing business is two years old. Many people date the beginning with introduction of the Altair computer on the cover of the January 1975, issue of *Popular Electronics*. Others point out that there were significant developments before then (see "An Informal History of the Hobby Computer Market" in our January-February issue). But there can be little argument that the market as we know it today began with the Altair.

In these two years there have been a lot of firsts and some of the people who were first have reaped the benefits. Because Dick Heiser was the first to open a retail computer store, most articles on computer retailing begin with a few comments about his efforts. Because he was first, his picture is on the cover of the SCCS journal.

Because Mits is the largest manufacturer in the personal computing market, it has been running its "number one" ad in several periodicals. According to Mits, to be number one means that you can provide more product and service – and who's going to argue with that?

As one who has seen personal computing grow from a nearly bankrupt company of 15 to a multimillion-dollar industry of at least a dozen manufacturers, 200 retail outlets, six magazines, 100 clubs, etc., I say that claims of "number one" or "first" are a lot of bunk.

The reason is simply that the market is growing and changing so rapidly that being first or number one can easily be lost in the shuffle. If Texas Instruments announces a personal computer next week, will Mits still be number one? Who opened the first Radio Shack store? Does anyone care?

This is not intended to knock Dick Heiser or Mits. It is just meant to point out a little reality. At this point in time, the personal computing industry is relatively small. As a matter of fact, you could buy most personal computing manufacturers (assuming they were for sale) at a more economical price than you could buy some of the larger computers now on the market. In two years, when the personal computer is a ripe age of four, who's to say who will be number one or first?

Anyway, PERSONAL COMPUTING magazine is the first computer magazine to be carried on the rack of a neighborhood grocery store.

The POLY 88 Microcomputer System

If you are into computers or considering a system, the POLY 88 is the machine to contemplate.

HARDWARE

• Popular 8080 central processor • Single-board CPU with ROM, RAM, vectored interrupt, real time clock, single-step logic and serial I/O • Video interface card – generates video to TV monitor and provides parallel keyboard input port • Serial and cassette mini-cards plug directly into CPU with ribbon cables • Cassette • ROM monitor with powerful debugger, video software, bootstrap loader • Backplane and power supply on one board simplifies construction • Rugged 6 amp power supply • All circuit boards are high quality, double-sided with plated-through holes • System is compatible with a wide range of Altair peripherals • Minimum point to point wiring means that the POLY 88 kit can go together in three evenings!

ABOUT SOFTWARE

Software is the reason the POLY 88 was designed. The operator can proceed from higher level languages like BASIC to developing machine code with the aid of our assembler. Our BASIC is a full 8K BASIC with character and byte manipulation. Best of all, the programmer is finally free of the teletype emulation mode so the video display can be used to full advantage.

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The POLY 88 was designed for ease of use. No one should have to learn all the inner workings of computers just to enjoy one at a reasonable price. With the POLY 88, you can "play" pre-developed programs or explore the world of computer languages as your interests expand.

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SYSTEM 1 — Kit includes 8080 vectored interrupt processor with real time clock, ½ K of RAM and 1K monitor on ROM: Video Terminal Interface displays 16 lines of 32 characters on a video screen and has a keyboard input port; cabinet, backplane, and power supply; complete assembly, operation and theory manual. $595.

SYSTEM 2 — System 1 plus 64 character line option and Byte/biphase cassette interface kit. $690.

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SYSTEM 4 — The complete kit. It includes system 3 *and* TV monitor, keyboard and cassette recorder with all necessary cables and connectors. $1350.

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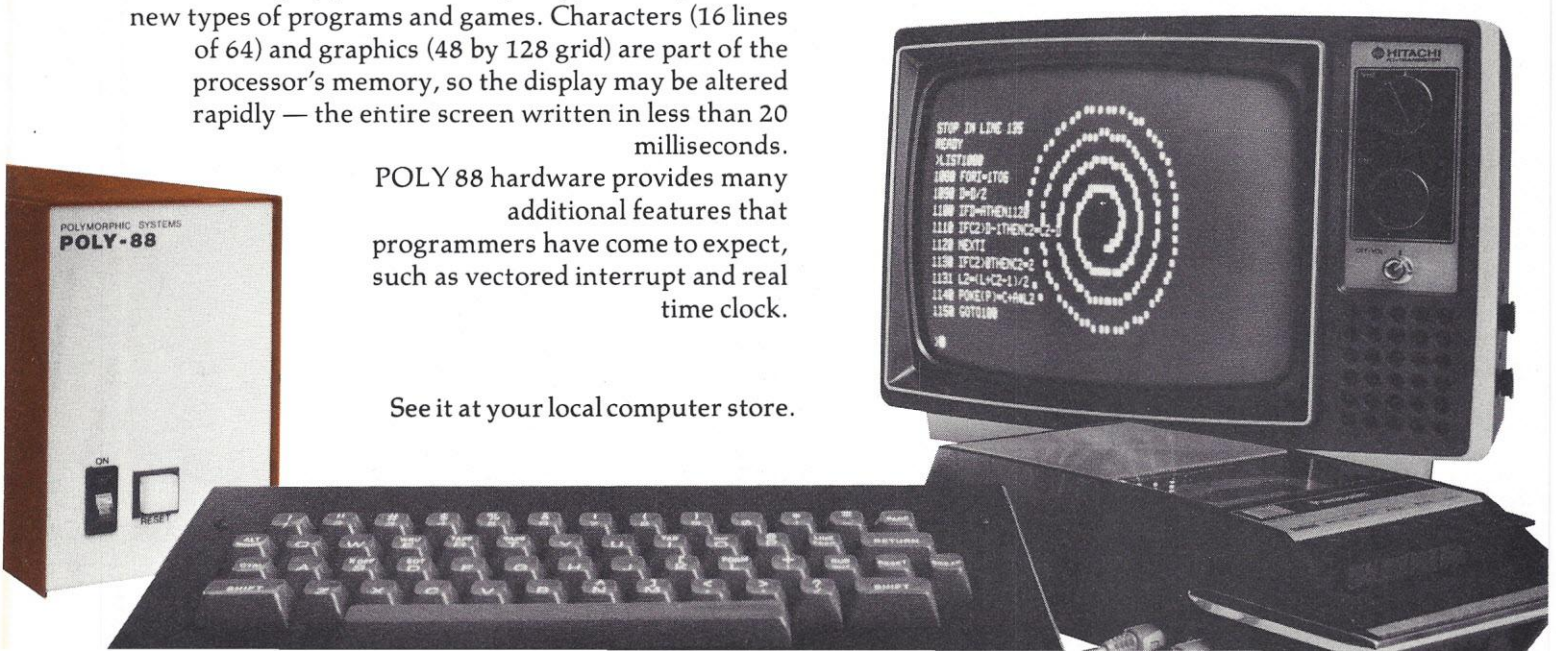


Speak clearly into the vase

The man in grey Hush Puppies scans his list. "I haven't called London in a while," he thinks. Wiring his "infinity box" to the telephone, he places the call. The phone in London doesn't ring. Well, actually it does, for less than a second. Our man cups the earphone closely and listens. He can hear everything said in the room 3000 miles away.

Infinity boxes, the latest thing for the professional eavesdropper, amplify the vibrations voices impress on the bell's magnetic coils. There is only one drawback: you can't use it through a switchboard number. But that's okay. The right people usually know the right numbers to call. Direct dialing to other countries is new but expanding.

In fact, our spy friend can use a personal computer to automatically dial the calls and record the conversations. A small unit neatly tucked away in the corner of the room can handle all his work for the day. He can program it to call at the best times, even if he is unavailable. When it's 8 a.m. in London, it's 3 a.m. on the East Coast, and he needs his sleep.

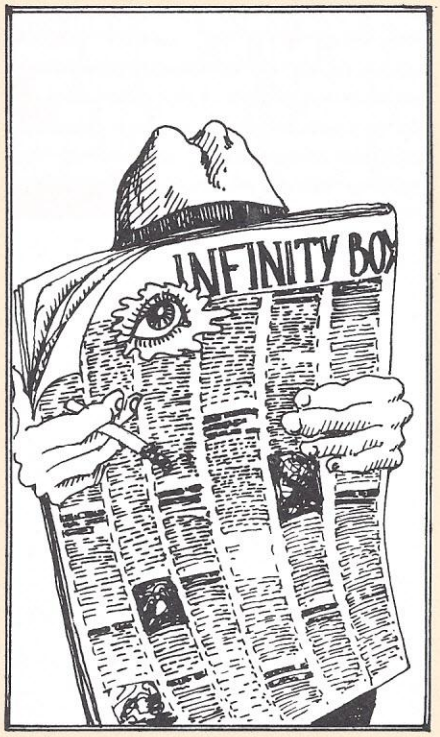
Not everybody can afford an infinity device; it costs a few thousand dollars. But if you really want one, you can get it without much trouble.

If you are really strapped for cash, try the Johnson and Smith catalog. It was required reading in my neighborhood. Containing a plethora of jokes, novelties, itching powder and pepper gum, it shows signs of the electronic age. You can buy a wireless transmitter (fool your friends, amaze your neighbors) for under $10. Not very sophisticated, but placed under a park bench it enables you to hear all the action on your transistor radio. It's legal for fun — not if you're serious.

But eavesdropping is serious business. Bugging and surveillance stab at our privacy — something we hold sacred. We think of privacy as a "right." But is that right written anywhere? Is it in the constitution?

Only suggested, the right of privacy is not among any one amendment. Jurists agree on that much. Attorneys do cite amendments in court, however: I, IV and III, in that order. Let's discuss these three.

The First Amendment guarantees freedom of speech. Nothing specific here, although Justice Douglas commenting on a case before the Supreme Court said: "Monitoring, if prevalent, certainly kills free discourse and spontaneous utterances. Free discourse — a First Amendment value — may be frivolous or serious, humble or defiant, reactionary or revolutionary, profane or in good taste; but it is not free if there is surveillance." He clearly sees bugging as a violation of the First Amendment. Others, including justices who dissented in that case, see no connection at all with wiretapping.



Search and seizure is the Fourth Amendment's theme: "right of the people to be secure in their persons, houses, papers and effects against unreasonable search and seizure." Interpretation of the word "unreasonable" is up to the Supreme Court. A court order, based on evidence brought before a judge, is usually considered reasonable, but it varies from case to case. "Emergency" taps are also deemed as reasonable; but what constitutes an emergency? Who decides?

During colonial times, soldiers stationed themselves in individuals' homes. The Third Amendment prohibits this practice. The roots of this amendment exist in common law, which states that "a man's home is his castle." Lawyers bring the Third Amendment into court to show that the right of privacy is strongly suggested in the Constitution.

In 1890, Louis D. Brandeis (later to be Justice of the Supreme Court) and Samuel D. Warren wrote in the Harvard Law Review, "That the individual shall have full protection in person and in property is a principle as old as common law; but it has been found necessary to define anew the exact nature of such protection." Although held valid in court, common law is open to question and broad interpretation.

Enacted in 1968, Title III forces the privacy issue. It provides for "48 hour emergency eavesdropping in cases of conspiratorial characteristics or organized crime." Also it allows the same emergency eavesdropping in cases of "national emergency." It opened a can of worms that continue to squirm around the courts. Although it is supposedly intended for organized crime, oppon-

random access

ents claim it has been diverted to other purposes. Since it will never flush organized crime, critics claim Congress had other uses in mind when passing the bill.

Also Title III bans private eavesdropping by non-governmental agencies: they may not manufacture, sell, distribute, transport or possess electronic devices designed primarily for surreptitious eavesdropping. The criterion for judging such a device, under this law, is whether spying constitutes the primary function. The bill has more holes than my socks.

You can change the advertising on such items; call them "telephone devices for the hard of hearing." You can sell individual parts to make the devices and wrap the parts in schematic diagrams. You can manufacture the visual surveillance equipment not banned by the bill. And you can mail them from Canada and Mexico.

Government can never eliminate snooping, especially since it may be the biggest snooper itself. Why should government be allowed to spy and no one else? We sit on a wobbly fence — we want to tap phones of those suspected of criminal activity yet protest our right to privacy. How can we do both?

The privacy issue will be kicked around in courts for years to come. In the meantime, I suggest that you and Mr. Butz don't say anything anyone would want to hear. — **Larry Kahaner**

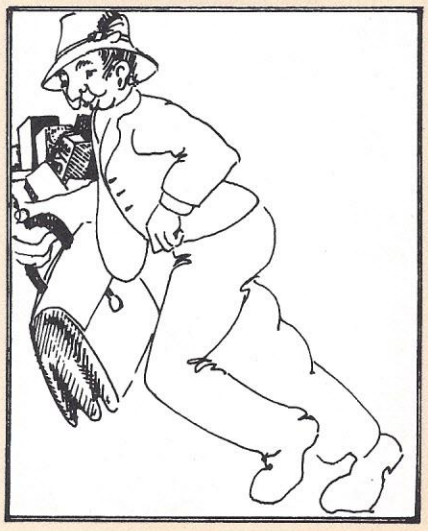
Dutch treat

Observers who looked fast and listened closely last November may have seen a harrassed-looking man run by and heard a flow of exclamations in Dutch from him. The audible apparition was Prof. Dr. J. Verhoeff of the Netherlands, who was scouring the country to stock the Byte Shop he had scheduled for opening in Amsterdam in January.

A representative of PERSONAL COMPUTING encountered the Professor Doctor on the San Francisco Peninsula when he was frantically searching for a Cyclops camera. He had the control board but couldn't get his hands on a camera anywhere, including at Cromemco, the manufacturer.

Three days later, "Graag!" the flying Dutchman descended on Pete Connor's store in Albuquerque, found a Cyclops there, cleaned a miscellany of items off the shelves as well, emptied his wallet, used his very last traveler's checks and vanished in the general direction of New York where he hoped a friend would be able to lend him a groat or two to get home on.

Since no missing person reports have filtered back from Amsterdam, Prof. Dr. Verhoeff must have made it. Folks are very big on ALGOL in Holland, and we look forward to reports of exotic new activity centering on the Professor Doctor's store.



The big one

The National Computer Conference will be held at the Dallas, Texas Convention Center this year, June 13 through June 16. This is the big computer show of the year, a spectacular display of systems and knowledge that's well worth attending at least once in your lifetime.

This year NCC is placing great emphasis on personal computing, with a Personal Computing Fair, Personal Computing Technical Program, Personal Computing Club Congress, Personal Computing Product Exhibit and even a designated Personal Computing Headquarters Hotel. Conference chairman Dr. Portia Isaacson has said: "It is our intention to create a national forum on personal computing where hobbyists and others can exchange new ideas and at the same time view the latest offerings from suppliers that cater to the personal computing market." She seems to mean it, too. NCC is doing its personal computing act in style.

NCC is sponsored by Afips — the American Federation of Information Processing Societies, a joint-action organization of related societies that otherwise act independently. Its management of these conferences has grown into a major, year-round effort. In 1962, the Spring Joint Computer Conference in San Francisco was staged almost entirely in a single hotel with the exhibits all in the ballroom of the Fairmont. By 1968, the Fall Joint Computer Conference exhibits in San Francisco filled underground Brooks Hall at the Civic Center, used hotel conference rooms all over town, and booked 100% of all the first-class hotel space in the city and 80% of the second-class space. Of the 50,000 people at the conference, those who had not reserved space well ahead found themselves at hotels 50 miles away.

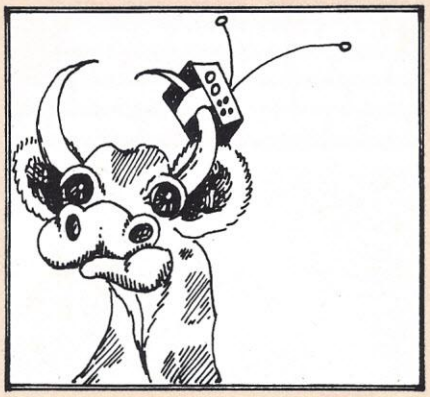
Times have changed. NCC is not closely limited to insiders, and this major push on personal computing is a significant sign of the future.

Make your reservations as early as possible. For NCC information, write to Afips at 210 Summit Ave., Montvale, N.J. 07645.

Computers for Bossy

In Holland, land of milk and cheese and milk and cheese, steps have been taken to use computers in keeping Bossy healthy and brimming with milk, not just in a general way but in a personal way.

At one experimental farm, each cow is equipped with an electronic unit that broadcasts its identification. At feeding time, when she sticks her head in a stall and is automatically locked in, a pick-up receives the identifying code



and reports to a computer the name of the cow and the number of the stall.

Using stored personal information about what Bossy has been eating and her age, condition and view of reality, the computer arranges to fortify each cow's food automatically. The report does not say that the computer hovers over the animal, saying "Now eat your supplements, Dear," but apparently the system is effective in persuading cows to produce lots of milk for cheese.

Phriendly phone pholks

When Computer Power and Light opened its store in Studio City, Calif. and installed new phones, the Yellow Pages people called shortly to sell advertising space and determine the appropriate heading for this new business listing. "List us under computer stores," said Susan Murrow.

"We can't," said Ms. Yellow Pages. "There's no such heading. Pick something we've got."

Susan did better than that. She assembled a list of all the computer stores she could find in California and sent a nice letter to the phone pholks, suggesting there **should** be a computer store listing.

After a short time, Ms. Yellow Pages called back and even sent a nice letter observing that the names of stores on the list were all legitimate and that they had been checked by diligent Yellow Pages operatives. Henceforth, a

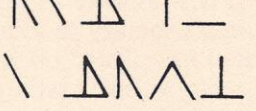
new category would be established in the Yellow Pages: Computer Stores. Lo, Compal's name would lead the rest ... in alphabetical order, of course. Susan triumphed.

Incidentally, it seems not entirely accidental that the last four digits of Processor Tech's phone number are 8080 in Emeryville and Itty-Bitty Machine Co. has nailed 6800 in Evanston. Others?

Everybody talks about hexadecimal

Our standard modulo 10 arithmetic notation is a bit awkward for use with computers, which operate more handily with numbers that are powers of two. There are those who wish fervently for a standard system of notation that would let us count from 0 through 16 without resorting to double digits or switching to alphabetic symbols along the way, as: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E. That's confusing. We might be better off with new symbols for our numbers in a hexadecimal system.

While most people let the notion drop at that, a few hardy innovators develop symbol sets that seem attractive and try to gain public support for them. R. O. Whitaker, president of Computer Compatible Instruments Inc. in Indianapolis, goes even beyond that. His company manufactures display **systems**, typewriters and computer peripheral equipment with a novel set of hex symbols. A letter from Whitaker looks as if it's written in Elvish or some such language derived from the Tolkien Trilogy. His phone number is printed on the letterhead **only** in the special characters, providing some frustration to the recipient who hates puzzles, even when the key is provided (see sample).



Whitaker's diligence is remarkable, though he finds himself being treated as a nut. "I think I was the

random access

only speaker ever actually ejected from a meeting of the (name deleted) Society," says he. "I have found considerable resistance to this idea, though **EDN** magazine did publish an article of mine a few years ago and generated some serious discussion." He is knowledgeable on the topic and has corresponded at length with others proposing various systems.

You might choose to help in the effort to make all our arithmetic notation computer-compatible. If there's a real interest, PERSONAL COMPUTING will report on the work and run articles.

Ringing response

Last month we pointed out the general observation that few women are prominent in personal computing and wondered why. An answer came to us from Patricia Wood in Los Angeles:

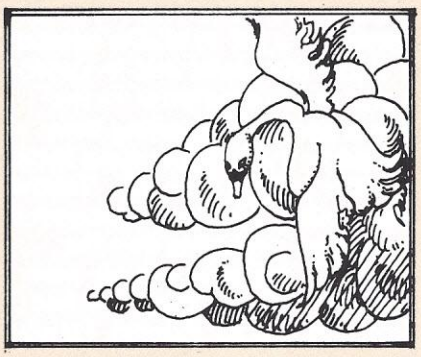
"I am a computer hobbyist who is a woman, and I don't think there is any barrier to women who want to be hobbyists. Traditionally, men have had the science-oriented minds and have left the women in the home to have babies, etc. I am glad to see this changing. I think women are realizing their interests and are doing something about it. I did something about it and built a microcomputer. It is a Mark-8 which implements an 8008 microprocessor chip. I am learning a lot and having much fun at my new hobby. I think there are a lot more women who are repressing their hobbyist desires only to meet up to the ideals society (a society of yesterday) has placed on them".

Tricia Wood isn't resting on her laurels but pressing on to teach others how to build kits. We've asked her to hold a training session at our Los Angeles Personal Computing show.

Getting personal with a 370

IBM is pointing proudly to use of its System/370 Model 158 by Me-Books Publishing Co. to print personalized books for children aged 3 to 9. A child who receives a book prepared especially for him discovers that he, his friends and his pets — by name — are heroes of the stories.

Me-Books carries a list of 28 titles, including variations of such classics as "Snow White," through



agreements with other publishers. In many of the books, the individual child's name appears as often as 70 times throughout the narrative, as well as his address and home town. In some books, the child's home address is printed on street signs in the illustrations. Nor are the names and special data just stamped into standard blanks.

The computer-controlled printing system prints the page — four at a time — and positions names in appropriate places. If names of friends or pets are not furnished, the system alters the basic narrative to exclude such references.

Printing is proportionally spaced to accommodate each child's name, regardless of its length. The page forms on which the text is automatically printed already contain color illustrations around which the text is automatically positioned. The printer processes the pages for several hundred books an hour.

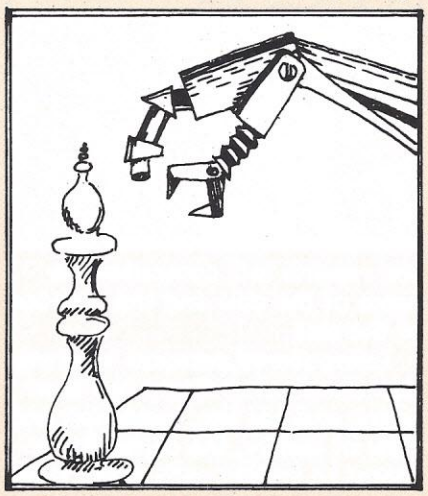
Me-Books, in Burbank, Calif., has printed and sold more than 3 million individual books in the past three years. About 50,000 members belong to a book club which provides a custom-printed book monthly to each member at a discount from the $4.95 list.

This elegant idea surely is adaptable in a thousand ways to applications in education and commerce.

WALDO games

U.S. Robotics Society plans to promote safety, fair play and systematic standardization of "rules, methods, mores and traditions" evolving with remote control games (see the WALDO article on page 98). USRS envisions many variants of WALDO (e.g., big, wild, sweet, wired, flying, mean, slow, fast, modest, baby, marine, crafty and good).

USRS is soliciting its membership for assistance in structuring and defining practical versions of WALDO to be played by



enthusiasts with varying resources in different environments. Nonmembers are invited to join USRS for participation in this program. Contact Glenn R. Norris, USRS, Box 26484, Albuquerque, NM 87102.

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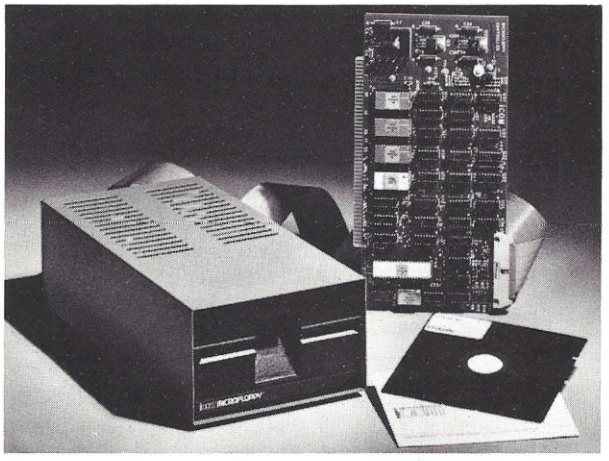
*Offer good through April 15, 1977



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CIRCLE 8

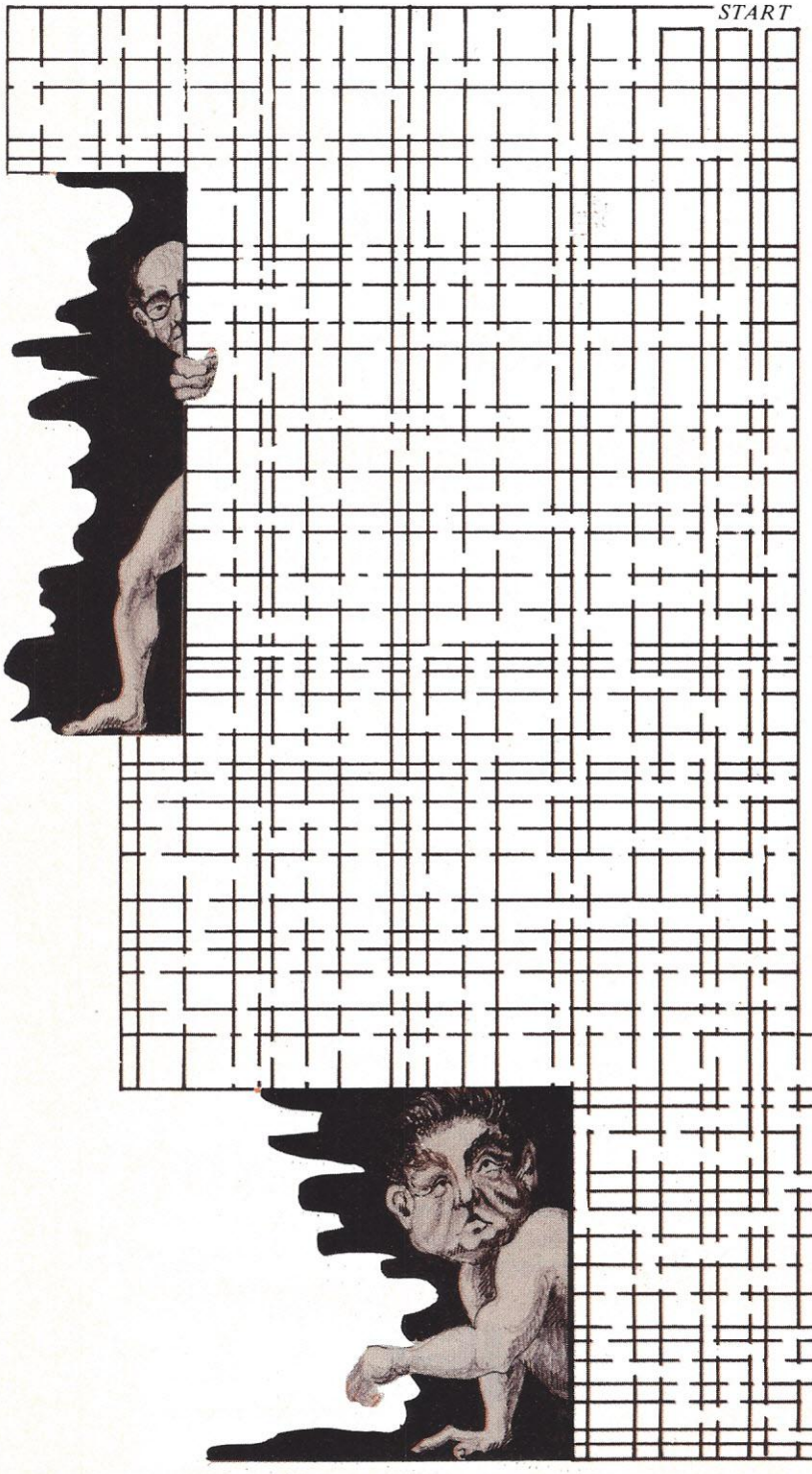
With Colonel Colt's six-gun, the uneasy average man was equal to the dangers of the frontier. The uneasy average man at today's frontiers of knowledge can hold his own with the personal computer. It is:

THE EQUALIZER

Although most of our population is still unaware that a private citizen now can easily have his very own computer, a few advanced thinkers have already pressed forward to the "What would I do with one if I had it?" stage.

PERSONAL COMPUTING will suggest an occasional thought about what might be done with a computer in an amateur setting.

For example, consider Computer Contact Sport, derived from a popular game. In this game, somebody names a famous figure anywhere in the world, and every player tries to figure out how many steps it takes to obtain a personal introduction to the Famous One, starting with somebody the player already knows personally.



Surprisingly, it turns out that anybody might wangle a personal introduction to anybody else in the world with only about five intermediate links in the chain. The winner is the player with the shortest necessary chain of contacts.

Politicians make good targets for the game. (What would you do with a politician if you had one?)

Consider Leonid Brezhnev, a hard-to-reach, hard-to-use sort of fellow.

I remember seeing a news picture of my friend George Glaser on a lecture platform with easy-to-reach Gerry Ford. The picture was taken when Mr. Ford was merely Vice-President of the United States and George was the distinguished President of the American Federation of Information Processing Societies. George qualifies as a linking contact with Mr. Ford. Never mind that Mr. Ford might not easily remember him. Mr. Ford knows Mr. Brezhnev. That's only two necessary links in my chain to Brezhnev.

Luckily, George has also been seen in public with Jimmy Carter.

Edward Teller?

My blind friend Tommy Jo reportedly delivered himself of a disapproving analysis of Dr. Teller while chatting with a stranger at a party. The stranger was Dr. Teller, of course. Two links again.

Humphrey Bogart.

Carl Weinstein used to insist in high school in Norwalk, Conn. 25 years ago that Lauren Bacall was his cousin. If I could only find Carl again and if Bogey were still with us . . .

Not a bad sport, and everyone can play. The reward for winning is usually a horselaugh directed at the winner for his labored name-dropping, but that's the fun.

And here is where the computer comes in. There's a second level of contact calculation that's far more difficult, less

fun but more useful and highly susceptible to computer aid. In this case, you're trying to contact people who are not famous.

Suppose you want to strike up an acquaintance with the vice-president of a small company in a distant part of the country. You want to sell him something, persuade him to join a professional society, or ask him to provide helpful information at some trouble to himself. Since you are strangers and he is busy, you surmise that it will be difficult to get his enthusiastic attention. You'd be well served if somebody you both know would introduce you.

How many links in your chain?

Hard to say. Maybe only one or two, a number you could manage very conveniently if only you knew who the contacts are.

Dig back through your files of business cards, correspondence and memories of people with whom you've had significant contact. Build a data base about these people, cross-referencing those who know each other, work for the same companies or frequent the same saloons. Tell your computer everything you can think of, giving it some way to recognize connections when it comes across them.

Do you know anybody on the board of directors in the general field of the man you're trying to reach? Directors commonly sit on the boards of various companies, not just one. (If you're careless enough to get maneuvered into being on one board, you are probably a sucker for other responsible positions, too.) Can you work through a short chain of contacts into the boardroom of that company whose vice-president you are stalking? Probably.

The trick is to find the connections that are not obvious, the dozens or hundreds of links you already have but never noticed. Organizing your information for the computer will reveal many surprising connections to you, even before the data are put into the system. Thereafter, the system will do the tedious linking for which you lack time or patience.

This is a classic personal computing application that demonstrates the value of the computer as an "equalizer," a tool that lets the little guy deal on an equal basis with the big boys.

Ralph Nader and Congress would throw tantrums if they discovered some big company systematically processing even public information about individuals to find useful social pathways. The underdog little guy actually has a major advantage in this fact. As long as he takes the trouble to maintain his image as a victim instead of looking like a bully, he can do what he pleases.

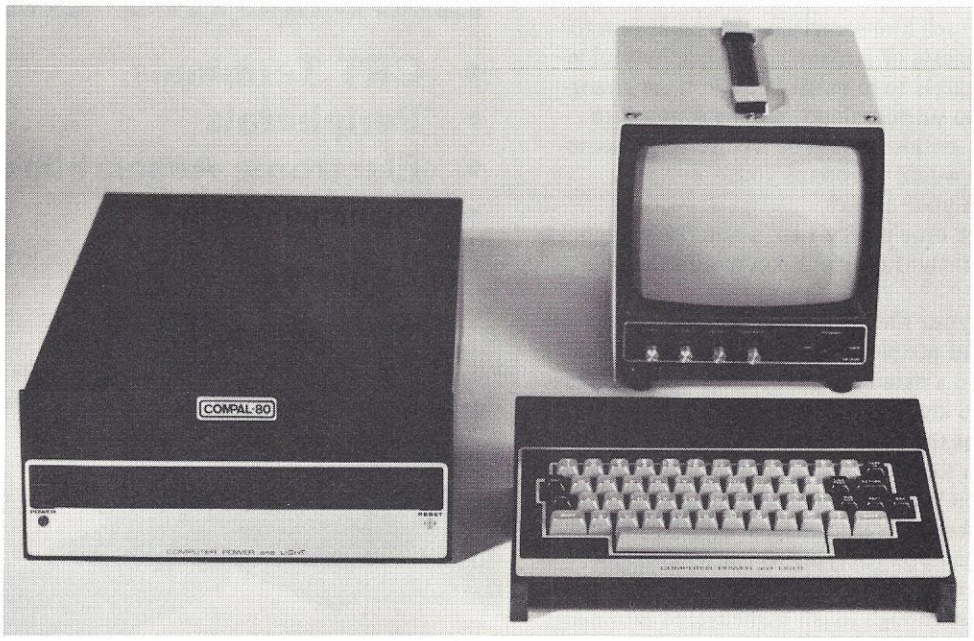
If a handful of computer amateurs pooled their resources, who knows what wonders of efficient communication might be wrought? ("Hello, Mrs. Gandhi? Dr. Chadragupta suggested that I call you about the new mango chutney standards. Hello? Hello?")

Developing this capability will be as onerous as any other effort to convert familiar information and methods to a new automatic data processing system, but what is amateur labor if not cheap and willing? This application may require a large amount of peripheral memory, too, but speed is unlikely to be a major concern. If you turn on a search in the evening and have a pathway mapped for you by morning, you'll probably be satisfied – for a personal application.

If you turn it into a commercial enterprise, you will stop looking like a victim and start looking like a bully. You will attract the Devil's attention and he may fly away with you. Every enterprise has its hazards.

Please drop me a note when you have this sort of system up and working. Now that I've done the easy part, I look forward to a horselaugh in reward. – **NBW III**

SEE THE LIGHT



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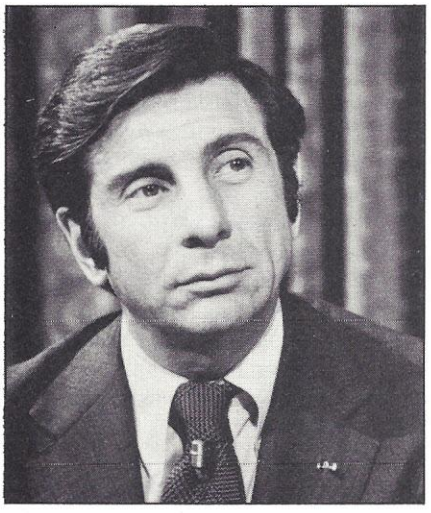
CIRCLE 10

A Personal Computing Interview

JULES BERGMAN ON COMPUTERS AND THE NEWS



As ABC News Science Editor, **Jules Bergman** is an "opinion maker." His judgments of what is newsworthy and what is not condition the attitudes of millions of people toward science and technology in our society. His views of reality – right, wrong, ill-informed, or soundly based on his research – are part of the American scene. PERSONAL COMPUTING chatted with Bergman at his office in New York in December 1976.

Personal Computing: *When we asked Donn Parker if he knew someone who hates computers, he instantly suggested that we talk with you.*

Jules Bergman: I don't hate computers! I think that computers are both a bright hope for our future and a fear for the future as well. Obviously, we have to watch what computers can do to hurt us as well as help us. They've gotten a bad reputation in many ways – some justified – for misuse for dubious purposes by federal agencies and industry.

What worries you?

Our all becoming 3BY74 computer ciphers or whatever, and all being recorded in some master file and being watched that way ... in a sense of deprivation of identity. Who am I? What am I doing here? Where am I going? I don't want a machine telling me. Obviously, used *intelligently*, the computer is a tremendous asset.

Does your business use computers?

We couldn't exist without them. By "we" I mean the networks. We use them in our master control rooms. A great deal of what you see is computer fed, racked-up and switched automatically in many places which you're not aware of, probably. Network engineering is so complex, that no single person, no four or five people, can understand it and run it.

Do you keep track of other things with computers?

We are going through an initial study phase at ABC News, on an idea I suggested, because we're all buried in paper. We're using a computer system with both CRT and hard copy very much like Mission Control at NASA in Houston to keep track of what our 1100 or 1200 people are doing.

Say you press a button (we haven't decided on all the codes yet): "Bergman, J." and up comes where I am and what I'm working on that day, all 3, 4, 5 or 10 stories ... if I'm in Atlanta filming this or that, or if I'm here. It saves 18 phone calls back and forth.

Also, by the way, it's a computer retrieval system. If you want to see what last night's Cronkite show had, we insert the formula for it and it's racked up. We monitor them; they monitor us.

Do you use computers to find news for you, not just collecting data, but making correlations automatically to derive information that's not obvious?

We plan to, but not quite that way. We already subscribe to the New York *Times* Data Bank, which is a computer retrieval system. Let's say we input "Swine Flu." It would tell us every story the *Times* has printed on the subject and gives us a copy of it in 39 seconds or something. As a research background, it's a start.

I manually clip what seems like 6000 technical journals I get a week. It's exhausting, but in the process of scanning and clipping them you also do

something the computer can't do... which is your mind *judging* the story. Is it worth *anything*? Or is it garbage in, garbage out?

The computer isn't going to turn up anything on the AP wire that isn't there. If something is there, someone who's reading it is going to find it, analyze it and decide if it has any news value .... Wilbur Mills was trapped and undone by an event, not a computer. Congressman Hays was undone by a secretary who said she was paid to sleep with him, not by a computer.

Would text editing be a useful computer application for you?

Oh yes. The wire services already use a machine with a CRT display and a memory that plays their text back to them so they can make any corrections they want to. What I really want is a machine I can talk to that will type a script or an intelligent letter. As a professional journalist, I'd find a voice recognition adaptive computer that I could dictate to and then have it type for me an enormous timesaver.

Some computer experts have sworn not to work on systems like that, because anything that can understand your dictation could be set to listening to you in a telephone tap. It could listen only for subjects of special interest that you're talking about, then switch on recorders to collect highly selective information. Does that hazard concern you?

I think it would require an enormous discretionary intelligence job to sort out the key phrases that are worth recording. Computing from the straight garbage of my saying: "This is a memo to Mr. Botts, on story so-and-so ... I'm not sure it would pay.

Do you think it's possible that personal computers will help people to change their identities, to create new names and lives for themselves to escape from the past – not from crimes but from hard lives?

You can fight the system with your own system. I'm sure that with enough knowledge of computers and software entry methods you could create a false identity and probably escape anonymously into the system. Why are you trying to start over?

This is just a desire for a fresh start.

I suspect that anybody who couldn't make it in his first identity and tries to create a fictitious new identity that becomes real, would fail again. I suspect that the same inbred genetic characteristics, environmental and educational drawbacks that made him a failure would make him a failure in his second life. He may fight that, may say: "I learned a lot in my 40-odd years. I'm much brighter, etcetera, all I need is a new identity ... and I'd marry a wealthy, beautiful nymphomaniac, set up a successful business, and live happily ever after" ... is a great pipe dream in my opinion.

Does personal computing increase the hazard to personal identity in our society?

Most people in our society believe that mini-calculators are computers. Half of them call them computers; that's how confused they are. I correct them. If powerful computers are available, then I would worry about their use by private individuals, too. They might try to blackmail me or sell the story of my sex life or whatever, the same as the government or a corporation could. I *am* deeply concerned with the loss of identity of the individual in this country. I think that's the root of our discontent. The individual feels that he lives in an ocean of foul water, trapped air and pol-

If powerful small computers are available, then I would worry about their use by private individuals, too. They might try to blackmail me or sell the story of my sex life or whatever the same as the government or a corporation could.

iticians who don't care. Politicians don't begin to understand computer technology. There are very few exceptions.

Bigtime politicians use computers in their campaigns. Could smalltime politicians balance that power by using personal computers in their campaigns for alderman and the like?

I'm not sure it would work. It could obviously record your diaries, keep lists of people you've spoken to or whatever. I'm not sure it's going to help you win an election, though. I don't really think elections are won or lost that way. Elections, like news shows, are won or lost on personalities.

Not content?

Content, too. We like to think we do better things on our evening news than CBS or NBC. Distressingly, the polls indicate that the audience that tunes into the show do it not because of the operational people like Jules Bergman or Sam Donaldson but because of the personalities of Harry Reasoner or Barbara Walters.

I really think that's how elections are won, by the way. Carter, for example, was tremendously popular; he was Washington's fresh face. That's how he won the primaries, then the nomination. Then, when he got down to specifics, he made boo-boos as well. When pressed for answers, he wasn't very good at a lot of things and his Southern accent sometimes became a mask for lack of clarity. Personality was the key.

The computers did a marvelous job

in forecasting trends in this election and called it very closely. That doesn't mean I trust them.

You don't think computer processing makes false things true?

You can feed things into a computer to prove anything you want to. There are a fair number of scientific and technological phonies who know full well how to turn up hysterical reports like the original ozone reports, when in fact we're still several decades away from knowing whether there's any real risk... and there was the cyclamate affair .... and now they're after saccharin, obviously a deadly product. It's only been used for 110 years, during which period the rate of stomach cancer, intestinal cancer and the like has declined.

Is any threat from computers worsening?

I think the change at this point is somewhat for the better. Up to a couple of years ago, when the whole business about the secrecy began to break open, it was changing much for the worse. You were reduced to a card in the FBI files, sold to people. I think now because of the general disclosure attitude that there are changes at least superficially for the better.

And this is because of ...?

Congressional investigation on protecting individual rights, etcetera, committees looking with great alarm at what the computer can do. I'm optimistic enough to believe that our system, working not too well at the moment, can work better and will work better.

You can feed things into a computer to prove anything you want to. There are a fair number of scientific and technological phonies who know full well how to turn up hysterical reports.

Do you see good things happening with computers?

I suspect that the most newsworthy thing in computers in the immediate future, in terms of social usage, is new medical applications. For example, we have a whole new generation of diagnostic devices that let us see things about the body we couldn't see before, like a computer-controlled heart scanning device with a CRT display. The image shapes itself up and, lo and behold, it's a heart with a left ventricle and a right auricle, working. The system is noninvasive and lets you see what's wrong with the heart if you know what you're looking for.

What about handling medical statistics?

I think you could make a distinct medical advance if we all carried small computerized cards that stated our medical records, allergies to penicillin and so on, in case we collapse in the street or are hurt in accidents. It would save the hospital an enormous amount of time in testing and save lives. Some people regard this as too much of an invasion of privacy. A lot of people lie about their medical histories for various reasons ... you'd have to have elaborate safeguards built into the system ... but you see what I'm getting at, not an invasion of privacy, not 1984-ish, but utopian in the sense of improved medical care.

All of us who watch television identify you with the space program. You've probably had more opportunities to play with fascinating hardware than the average person can imagine. Have you ever actually used a computer to do a personal job – as opposed to experimenting with a system set up for some other purpose?

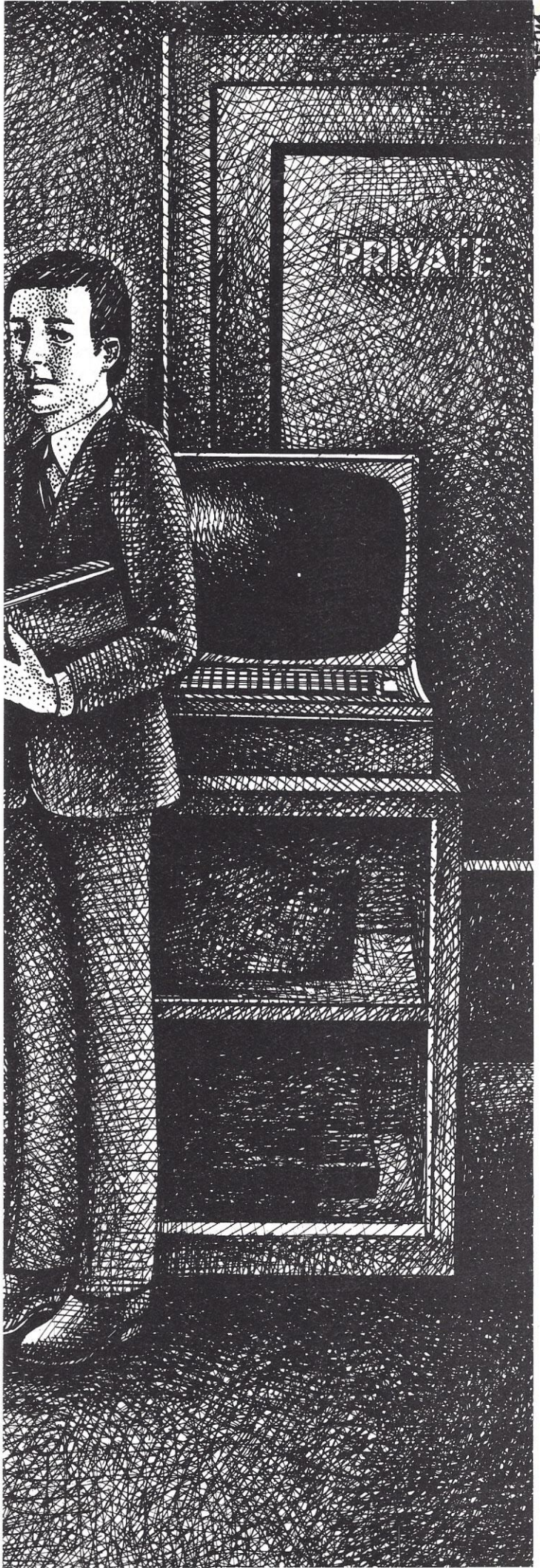
Yes. First of all, the entire space program could not have *been* without the computer. Now, remember the Apollo 13 flight ... I came back from dinner just as the transmission came on and the guys looked OK. Just as it was ending, there was a strange clicking sound and Lovell quietly said: "Something is wrong." (He didn't say "We've got a problem," as far as I can tell.) The wrong, of course, was the explosion of the liquid oxygen tank in the service module. As soon as I heard that, I knew the mission was aborted. The only concern was: "Could you get them back?"

The shortest way back was to circle the moon. The question I had was, did everyone on board have enough oxygen to get back? NASA had just barely admitted they had a problem. This was about 10:30 at night. We had "taken" the whole network for news. We were doing it live for 18 hours, so obviously we were all concerned about getting them back safely.

No one I could think of could give me an answer to the oxygen question. Now it was about midnight, but I called a friend in Houston who worked with the computers all the time and asked her to figure this out for me, working with what we knew about the oxygen supply, the necessary flight time, etcetera. She came back about an hour later and said yes, they had enough, but it would be very, very close. Not even NASA knew at that time. Even using the lunar module supplies, they had only one hour left when they landed in the Pacific.

Without the computer's help through my friend, I would have sat back and been as big a dummy as the rest of the networks were. That's an example where a computer is beautiful. A personal computer could have handled that problem very easily. Of course, I was broadcasting at the time and couldn't have taken time out to operate it; it proved to me the personal value of computers beyond the shadow of a doubt.


LEMONADE
COMPUTER
SERVICE
Co.
26



Lemonade Planning Service

by Glen Norris

The premise of the Lemonade Computer Service Company is that almost anyone can put off complaints that he is "just fooling around with an expensive toy" by going into business with his personal computing system – any business, however trivial. This is compatible with our tradition that paper routes and lemonade stands are worthwhile institutions. The Lemonade Computer Entrepreneur also stands to make a buck (well, maybe a dime), while risking no more than he'd spend on a pure hobby anyway. Here, Glenn Norris outlines a fundamental Lemonade enterprise – the business of designing businesses.

Statisticians report that more businesses fail than succeed and that the primary reason for failure is undercapitalization. The error of undertaking a business with inadequate resources is not always the product of poverty on the part of the businessman but more often the product of his ignorance; at least, so it seems from my experience.

Many new ventures survive because of the obstinate optimism of the venturer who works himself almost to death in defying all obstacles and prudent objections to his method of operation. A certain amount of craziness is not always harmful to beginning businesses; it may even be necessary.

Ignorance is not *always* harmful, either, just usually. The obstinately optimistic venturer often refuses to recognize the "tyranny of the numbers," the persistent, relentless requirement to come up with money and work day after day, month after month, while his sources of income are slowly developing. Wrapped up in the excitement of his marvelous technical or entrepreneurial idea, he may refuse to discipline himself, to work out the boring, spirit-crushing details of his day-to-day business. He may prefer the bliss of ignorance to the grinding labor of figuring out what he's really doing.

It's a truism that everything is harder than we think. Looking back on history, virtually every successful venturer in business, sport, exploration, war, or whatever, comments that if he'd known ahead of time how difficult his task would be, he wouldn't have had the heart to undertake it. No matter how hard we expect new ventures to be, they almost always turn out to be harder. No matter how well we prepare, we're never ready for reality, but we improve our odds of success with preparation.

Never mind the positive side of new ventures; that part is fun. Anybody can weave dreams, project sales realistically or not, point to the possible inflow of big money. Few can perceive and document the negative side of the venture, detailing the outflow of money.

That's been my business for some years: figuring out in detail how much money is needed to accomplish some business objective and documenting the realities so that entrepreneurs can grasp them ahead of time. (As an engineer I came to this from the technical side, but it's impossible to deal only with technology. So my concerns have expanded greatly.) Inevitably, our best estimates of the future are slightly mistaken, based on imperfect advance knowledge, too optimistic or too pessimistic.

Even so, the estimates themselves lend strength to a venture, assuring the venturer, investors, bankers who can lend money, suppliers who offer credit and even customers (who want to know that they'll get what they pay for) that the entrepreneur has really considered everything, that his judgments are not based entirely on ignorant optimism.

In theory, the task of estimating business and project costs is simplicity itself. The venturer sits down at a table with a pencil and a pad of paper to make a list of all the items that will cost money or time. (Time translates to money

if somebody is being paid to do work.) When the list is complete, the venturer pencils in next to each entry the amount of money he thinks will be necessary to take care of the item. Then he adds it all up and has his estimate.

In practice, he finds that complications creep into the job. For example, even if he orders some equipment on the day the project begins, it may be weeks before the equipment arrives. There's no point in hiring somebody to use that equipment before it's available, so the estimate should probably include remarks on timing. Prices change, too, sometimes depending on the season. Can the project save a lot of money by waiting until spring to begin? If so, the judgment had better be built into the plan. A hundred small considerations of this sort must be dealt with at every step of the estimate.

The eager venturer wishes at all times in this process to throw the papers out the window, determine his estimates on the basis of general experience and intuition, and go back to his "real" work. In fact, his intuitions are probably good if his experience has been relevant, and some new undertakings have prospered without layout of a formal plan.

If a Lemonade Planner equips himself with a list of good questions to ask and with a few small programs that will let him process the answers to those questions, he can perform a valuable service to venturers and project leaders. He can hope to be paid for that service. His task is to lead the venturer through the questions, to force the discipline not by pushing but by pulling, attracting the venturer through the process.

The Lemonade Planner has a great advantage; it's easier to bear other people's pain than one's own. He needn't suffer personally over each point, worrying about the promises that have been made, the enormity of the work being outlined, the gap between money in hand and the amount that must be paid out if the venture is really undertaken. He can be dispassionate, can accept that the project may be impractical.

More, he can print out his reaction to the project in dispassionate form, without added color and judgment. His programs will churn through his computer with the data, causing a teletypewriter to present the cold figures in columns and rows for prudent inventors and lenders to study.

In fact, many investors and lenders are not prudent. They don't study the plans in detail, don't ask for the worksheets from which they were produced, don't ask the proper hard questions. They take comfort in the knowledge that the venturer has actually done his homework, has forced himself (or been led) through all of this detail. They can't tell whether his judgments are correct or not, but they know that he's considered all the details, doing a conscientious job.

The purpose of this article is to provide the Lemonade Planner with an outline of his work with a few examples of questions and answers, and with a little program that will get him started on one major part of the planner's job.

What follows is a modest beginning for the Lemonade Planner who wants to give this a try. The Lemonade Projection Program is limited to payroll in this form, to that major factor in any project. Any programmer of moderate skill can alter this basic piece of work to include other factors.

The Lemonade Projection Program was written in BASIC for a Data General Nova computer. The program can be adapted to run on most personal computers.

The program asks leading questions, as indicated in the sample run. The variables to be entered are:

Salaries

Starting month on project, coun-

ting from January
Length of time on project

The program is based on a 40-hour work week and contains the following items of time-paid-for-but-not-worked:

Vacation – 10 days/year, prorated to 6.6666 hrs. per month
Holidays – 8 days/year, prorated to 5.3333 hrs. per month
Sick Leave – 6 days/year, prorated to 4 hrs. per month

Other items appearing on the printout are employer paid and are:

Group Insurance, includes health, life or whatever. $46.50 per month is allocated for this item.
FICA – 5.85% of the first $15,300 for the first year (1976) and 5.85% of the first $16,800 for subsequent years.
Unemployment tax – Federal and state taxes for a total of 4.1% of the first $4,200.
Cost-of-Living Factor, inflation is figured at the rates indicated in the discussion of the example projection earlier in this article.

This small program and very limited discussion of Lemonade Planning should provide the beginner with an adequate start. The libraries are full of books on small business operations that will suggest many alternative approaches to this endeavor.

As Lemonade Planners begin to exercise their skills in communities all over the countryside, the rate of business failures may be reduced, except possibly among Lemonade Planners, who may not have the discipline to plan their own activities with the same care and skill they offer to clients.

NOTE: Punched paper tapes of both the Lemonade Projection Program and the more complex technical development program discussed in this article may be obtained at a modest fee from the author. Write: Lemonade, Personal Computing, 401 Louisiana, S.E., Suite G, Albuquerque, N.M. 87108

An Example of Cost Projection

The material here is drawn from a real technical project whose purpose was to develop a recording and playback system. This aspect of the task was all concerned with the way in which money, effort and time would be *spent*. Not only does this omit estimates of income from sales of products and services, it omits most expenses relating to overall company operations, administration, marketing, customer support and all those things that are necessary in the general operation of a business.

The Lemonade Planner will want to deal with all of those other concerns as he goes along and he needn't worry unduly about them, because he will start at a small scale, working up to complex projects like this one only gradually. The point is that both big projects and small ones are much the same. The basic questions are all alike. The need to start at the beginning and work steadily to the end of the task is the same whether one is planning a Junior Achievement company that will manufacture a few kites or the introduction of a major new consumer product by a huge company that will spend $20 million on the project.

Definition of Project Objectives and Goals

It's always surprising to learn that many venturers fail to define their goals clearly. They want to "be in business" doing something that appeals to them, but they may not have decided clearly whether their real objective is to become rich and employ a lot of people who will also make a lot of money or to do something wonderful for humanity, providing new capabilities to people who are in need of them. Maybe both purposes are served, but the venturer must tell the Lemonade Planner what he has in mind so that the calculations can take his purposes into account.

In this exercise, the object was clear cut; to develop hardware, knowhow, and plans that could be given to a manufacturer so that he could begin to make and sell a product and related services. The venturers knew that time was limited, that if the work took more than five years it would be useless. They were shooting for about three years. They knew that they couldn't have $20 million for the task but that they might have $3 million if the job really called for it. They specified the technology, the desired product of the work, very carefully. The specifications for the development project ran to perhaps 20 typewritten pages with half a dozen sketches, supported by three patent applications and a notebook detailing laboratory work performed to show that the project was possible.

Definitions of Major Tasks

It was clear that several major technical development tasks had to be pursued in parallel. If a very small team did one task after another, time would soon run out. So seven major technical tasks were identified. This was the list:

Major Tasks With Primary And Secondary Approaches
(*signifies primary approach)

MOLDING TOOL
*Design in house and Job Shop fabrication
Contract to outside firm.
IMAGE PROCESSOR
*Adapt available Flying Spot Scanner
Design and Assemble new system
SOUND PROCESSOR
*Develop Optical Fourier Analyzer
Adapt conventional computer Fourier processors
MASTER ENGRAVER
*Laser Ablation Technique
Photochemical Etching
AUDIO REPRODUCTION
*Mechanical Sound Synthesis
Electronic Sound Synthesis
RECORD ASSEMBLER
*Filter and Data Disc
Unitary Filter and Data Disc with Dust Cover
PLAYBACK INSTRUMENT
*Design and Fabricate Inhouse
Contact to outside firm

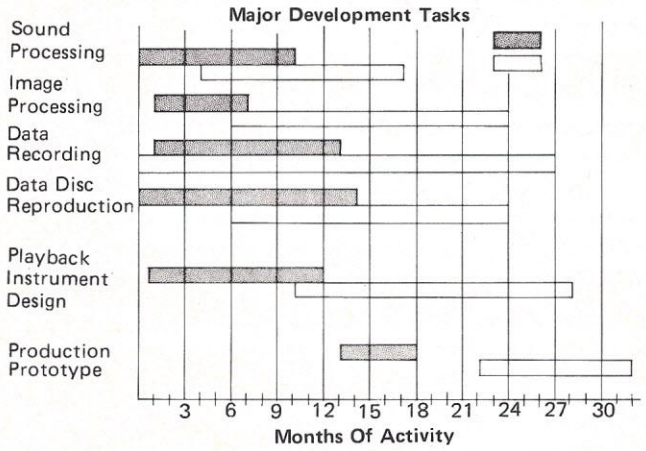
The secondary approaches were technical alternatives to the primary approaches. It was probable that one or another of the chosen techniques would prove technically impractical or uneconomical. So it was determined that alternate techniques would be pursued at the same time. As soon as one worked economically, the other would be dropped. Again, time was the consideration. The tasks couldn't be done serially within the allowable time limit.

Charting

With objectives and major tasks in view, it was possible to plot major activities against time. In this case, the general body of information was sliced a slightly different way. The chart that follows is just one of half a dozen charts that plot the venturer's best estimate of when tasks would begin and end for development of two different models of the products. (Two models? Yes, that's another variable that the venturer reveals to the planner's surprise.

Each major task is broken into sub-tasks, of course, and so charts like this are clipped together in little stacks as more and more questions are asked of the venturer. Information that allows this plotting is derived from many sources. In this, for example, is included the information manufacturers provide about the availability of their products, delivery times, estimates of the time needed for a machine shop to carve pieces of steel and aluminum into particular shapes, and guesses of engineers as to how long it will take them to work out their special sub-tasks.

Notice that the lines don't all begin at Day One. The venturer can get a sense of pacing from these charts, change them to suit staff and budget, begin to shape the project.



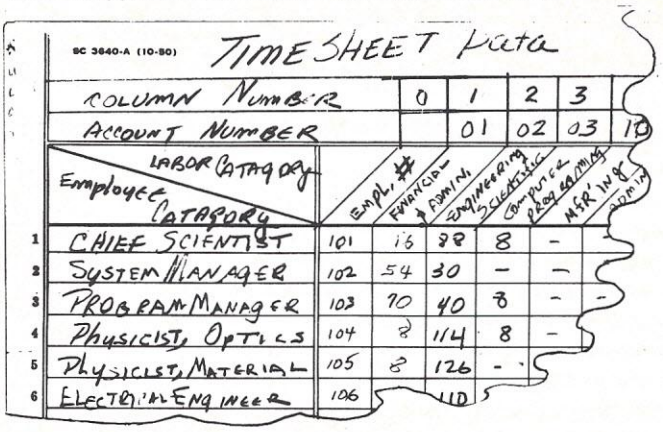
Staff Composition

Here's another piece of laborious homework that must be performed "by hand." Notice that computers are nowhere in evidence in this estimate yet, except as systems that will be used later in the development project. Thus far, the planner's task is to ask questions and write down answers. The next appropriate questions deal with staff. "How many of what kind of people are necessary to accomplish the major goals, as represented in the breakdown of major tasks, in the estimated necessary schedule already determined?"

The planner makes up a list of job titles, then tries to allot each team member's time in some sensible way to do the work. The sheet following is a real worksheet from a stack of 50 or more used in estimating this developmental project. Really, this is a projected time sheet, guessing how each worker will spend a typical month. Notice that even the mechanical technicians spend a lot of time on "Financial and Administrative" work as well as laboratory technical work, fabrication and assembly, and the like. They have to fill out time sheets, make reports on materials that have been used and look after a lot of seemingly unproductive chores. Presumably, each team member will be sick once in a while or have to attend funerals or otherwise consume time unproductively, for good reason.

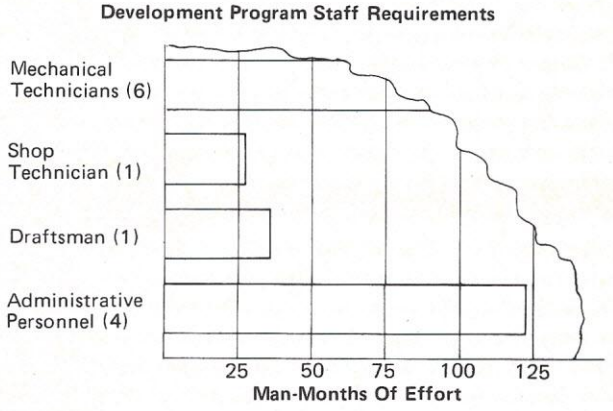
That's on the worksheet here, getting ready for computer processing. The sheet is cluttered with account numbers that fit the venturer's accounting system and various important notations that the planner worries about. Incidentally, variations of this worksheet can be found in almost any office supply store. Even the Lemonade Planner working on a shoestring will find his tasks eased significantly by use of such forms in which he can set up his own categories of information. No single form is "right," and any simple layout will serve many purposes.

In fact, the entries on this sheet were altered a dozen times and a number of staff members were added as it became apparent that the work needed more hands.


SC 3640-A (10-80) TIMESHEET Data

	COLUMN NUMBER	0	1	2	3	
	ACCOUNT NUMBER		01	02	03	10
	Employee CATAGORY / LABOR CATAGORY	EMPL. #	FINANCIAL & ADMIN.	ENGINEERING SCIENTIFIC	COMPUTER PROG. SOFTWARE	MGR'ING ADMIN
1	CHIEF SCIENTIST	101	16	88	8	-
2	SYSTEM MANAGER	102	54	30	-	-
3	PROGRAM MANAGER	103	70	40	8	-
4	Physicist, Optics	104	8	114	8	-
5	Physicist, Material	105	8	126	-	
6	Electrical Engineer	106		110		

From the scheduling and staff worksheets, it was possible to produce a bar-chart showing the total anticipated expenditure of time on the project, broken into handy categories.



Calculation of Payroll Related Expenses

At last we have something that can usefully be run in a computer.

We have an idea now of the number of people involved in the project, their rates of pay, and the schedules on which they will join and leave the project staff. This information, along with projections of related expenses for Vacations, Sick Leave, Holidays, Other Paid Absences, FICA, FUI, and Employee Group Insurance are processed to provide a real picture of expenses. FICA, by the way, is Social Security and FUI is Federal Unemployment Insurance, to which may be added

half a dozen more state program costs of one kind or another. These are not just deductions from the employee's salary but involve taxes upon the employer directly. Their cost is appreciable (and may take the naive entrepreneur completely by surprise.)

Not only that, the figures aren't easy to calculate. Suppose, for example, that an employee making $28,000 a year joins the staff on I January. He must pay (and the employer must pay) Social Security taxes on the first, say, $16,800 of his yearly income. Because he'll have made that much by some time in September, the last three months of the year won't require those payments against his salary. If everybody started work at the same time he did, the effect would be to drop out-of-pocket operating costs appreciably for the company in the last quarter of the year. However, if people start later and make less, then the Social Security payments for them run right through the end of the year. It isn't hard to understand the theory of this, but it's a nightmare to figure out what will actually happen. This is where the computer does its work.

All The Rest Added

In this case, actually, the program accommodated a good bit more than payroll. Everything that had been laid out was dropped into the computer system, processed and printed out in a variety of formats that would be of interest to people with different concerns.

Here is one such printout. This developmental program was designed to use slightly less than $2½ million in a period of 36 months. It's unlikely that the beginning Lemonade Planner will be asked to handle an undertaking of this scope, but by the time he has a few jobs behind him, this will be easily within his capability.

```
RUN
     PROGRAM ALLOWS FOR COSTS OF INFLATION.

(1)  PROTOTYPES AND TOOLING
(2)  MACHINERY AND EQUIPMENT
(3)  ENGINEERING DIRECT CHARGES
(4)  INDIRECT TECHNICAL CHARGES
(5)  GENERAL AND ADMINISTRATIVE
(6)  TOTAL FOR THE MONTH IN DOLLARS X1000
(7)  CUMULATIVE SUM IN DOLLARS X1000
(8)  NUMBER OF MONTHS

 (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)

 3.27      5.63      18.67     14.64     7.88      50.09     50.09     1
 6.23      4.53      18.77     14.72     18.19     54.44     104.53    2
 12.18     9.11      22.67     14.8      9.11      67.86     172.4     3
 5.95      3.43      23.51     15.45     8.36      56.71     229.1     4
 10.7      9.32      22.79     15.54     8.4       66.75     295.85    5
 12.96     3.47      23.65     15.62     8.1       63.79     359.64    6
 40.13     3.49      25.31     15.7      8.14      92.77     452.42    7
 .52       0         14.65     7.68      10.94     33.8      2292.5    32
 .52       0         14.71     7.19      5.23      27.65     2320.16   33
 .52       0         14.77     7.22      5.25      27.76     2347.91   34
 .53       0         14.82     7.25      5.27      27.87     2375.78   35
 .53       0         14.88     7.27      5.29      27.97     2403.75   36

 629.4     67.98     854.67    542.16    389.54    2403.75   2403.75   36
*READY
```

As you can see, this developmental program was designed to use slightly less than $2½ million in a period of 36 months. It's unlikely that the beginning Lemonade Planner will be asked to handle an undertaking of this scope, but by the time he has a few jobs behind him, this will be easily within his capability.

Notice that it's easy to draw up graphs (or teach the computer to do it) from these figures. One can easily show the rate at which cash is required for the project, month by month over its life. It is clear as well that technical labor costs (see totals for columns 3 and 4) are by far the largest portion of the total budget. If the venturer wants to make a significant change in the cost of the program, he'll have to start with the cost of people. In this listing, the General and Administrative category includes items like travel, legal (including patents), accounting, telephone ($26,600 worth of phone calls), office supplies, laboratory supplies (consumables like solvents, film, etc.), maintenance and repair, rent ($83,000), equipment lease (computers, for example), utilities, insurance, miscellaneous, recruitment and moving of employees.

The Lemonade Planner will probably not want to lump these items in a broad category for small-scale projects, but will break them out where they can be seen by the astonished venturer who doesn't realize what a persistent drain these items are on his resources.

So far, this is all straightforward, not very interesting and not much of a demonstration of what the computer is good for.

```
RUN
TOTAL NUMBER OF EMPLOYEES? 7
EMPLOYEE #,ANNUAL SALARY $ ?, START MONTH # ?, MONTHS WORKED ?

EMPLOYEE # 1 ? 12000? 1? 18
EMPLOYEE # 2 ? 9000? 3? 18
EMPLOYEE # 3 ? 8500? 1? 15
EMPLOYEE # 4 ? 7000? 1? 12
EMPLOYEE # 5 ? 7500? 6? 20
EMPLOYEE # 6 ? 12500? 4? 8
EMPLOYEE # 7 ? 6000? 1? 26

YEAR # 1
NUMBER OF EMPLOYEES = 7 (NOT NECESSARILY ON PAYROLL ENTIRE YEAR)

ACCOUNT       1ST QTR     2ND QTR     3RD QTR     4TH QTR     TOTAL

WAGES         $ 8107      $ 12771     $ 13881     $ 12956     $ 47715
VACATIONS     $ 350       $ 552       $ 600       $ 560       $ 2062
HOLIDAYS      $ 281       $ 442       $ 480       $ 448       $ 1651
GROUP INS.    $ 592       $ 867       $ 957       $ 912       $ 3328
SICKNESS      $ 210       $ 332       $ 360       $ 336       $ 1238
OTHER ABS.    $ 176       $ 276       $ 300       $ 280       $ 1032
F I C A       $ 533       $ 841       $ 915       $ 854       $ 3143
UNEMPL. TAX   $ 373       $ 513       $ 248       $ 70        $ 1204

TOTALS        $ 10622     $ 16594     $ 17741     $ 16416     $ 61373


YEAR # 2
NUMBER OF EMPLOYEES = 5 (NOT NECESSARILY ON PAYROLL ENTIRE YEAR)

ACCOUNT       1ST QTR     2ND QTR     3RD QTR     4TH QTR     TOTAL

WAGES         $ 9552      $ 7662      $ 4332      $ 3000      $ 24546
VACATIONS     $ 414       $ 333       $ 187       $ 129       $ 1063
HOLIDAYS      $ 330       $ 264       $ 151       $ 105       $ 850
GROUP INS.    $ 684       $ 546       $ 365       $ 273       $ 1868
SICKNESS      $ 249       $ 198       $ 112       $ 78        $ 637
OTHER ABS.    $ 207       $ 165       $ 94        $ 66        $ 532
F I C A       $ 630       $ 504       $ 286       $ 198       $ 1618
UNEMPL. TAX   $ 441       $ 268       $ 67        $ 0         $ 776

TOTALS        $ 12507     $ 9940      $ 5594      $ 3849      $ 31890


YEAR # 3
NUMBER OF EMPLOYEES = 2 (NOT NECESSARILY ON PAYROLL ENTIRE YEAR)

ACCOUNT       1ST QTR     2ND QTR     3RD QTR     4TH QTR     TOTAL

WAGES         $ 1444      $ 0         $ 0         $ 0         $ 1444
VACATIONS     $ 62        $ 0         $ 0         $ 0         $ 62
HOLIDAYS      $ 50        $ 0         $ 0         $ 0         $ 50
GROUP INS.    $ 137       $ 0         $ 0         $ 0         $ 137
SICKNESS      $ 38        $ 0         $ 0         $ 0         $ 38
OTHER ABS.    $ 32        $ 0         $ 0         $ 0         $ 32
F I C A       $ 98        $ 0         $ 0         $ 0         $ 98
UNEMPL. TAX   $ 66        $ 0         $ 0         $ 0         $ 66

TOTALS        $ 1927      $ 0         $ 0         $ 0         $ 1927

     TOTAL COST OF WAGES            $ 73705.2
     TOTAL COST OF VACATIONS        $ 3190.7
     TOTAL COST OF HOLIDAYS         $ 2552.56
     TOTAL COST OF GROUP INS.       $ 5335.19
     TOTAL COST OF SICKNESS         $ 1914.42
     TOTAL COST OF OTHER ABS.       $ 1595.35
     TOTAL COST OF F I C A          $ 4856.21
     TOTAL COST OF UNEMPL. TAX      $ 2047.94

     PROGRAM TOTAL                  $ 95190

*READY
```

```
1REM TAPE # 123
LIST
1  REM  TAPE # 123
3  REM  S(X)=% ANNUAL MERIT SALARY RAISE
5  REM  R(X)=% ANNUAL INFLATION RATE
7  REM  A(14)=PROJECT WORK HOURS / MONTH
9  REM  A(15)=VACATION HOURS/MONTH
11  REM  A(16)=HOLIDAY HOURS/MONTH
13  REM  A(17)= GROUP INSURANCE $/MONTH
15  REM  A(18)= SICK LEAVE HOURS/MONTH
17  REM  A(19)= PERSONAL ABSENCE HOURS/MONTH
19  REM  A(20)= F I C A  $/MONTH
21  REM  A(21)= UNEMPLOYEMENT TAX  $/MONTH
23  REM  A(23)= WORK START MONTH COUNTING FROM JANUARY
25  REM  A(24)= #  OF MONTHS WORKED
27  REM  A(25)= ANNUAL SALARY RATE IN  $
100  DIM A[26],B[73],C[40,18],D[12],E[12]
105  DIM F[21],G[3],H[30],I[22],J[73]
110  DIM L[25,25]
115  LET S1=5
117  LET S2=5
```

```
119  LET S3=5
121  LET S4=5
123  LET S5=5
125  LET R1=8
127  LET R2=6.6
129  LET R3=5.7
131  LET R4=4.8
133  LET R5=4.6
135  LET A[14]=154
137  LET A[15]=80/12
139  LET A[16]=64/12
141  LET A[17]=45.6
143  LET A[18]=48/12
145  LET A[19]=40/12
147  GOSUB  2000
150  FOR K= 0 TO N7
151    READ N1,N2,N3
155    GOSUB  1100
158    FOR H=1 TO N4
160      LET A[23]=L[H,23]
162      LET A[24]=L[H,24]
164      LET A[25]=L[H,25]
235      IF (A[23]+A[24]-1)<N2 GOTO  630
237      IF A[23]>N3 GOTO  630
300      LET W1=1
302      LET W2=1
310      DATA  0, 1, 12, 12, 13, 24, 24, 25, 36
312      DATA  36, 37, 48, 48, 49, 60
320      FOR J=N2 TO N3
325        IF J>=A[23]+A[24] GOTO  620
330        IF J>=A[23] GOTO  340
335        LET J=A[23]
340        LET P=(J-N1)
345        LET B[J]=(A[25]/2080)*(1+N8)
362        LET C[14,P]=C[14,P]+B[J]*A[14]
364        LET C[15,P]=C[15,P]+B[J]*A[15]
366        LET C[16,P]=C[16,P]+B[J]*A[16]
368        LET C[17,P]=C[17,P]+A[17]
370        LET C[18,P]=C[18,P]+B[J]*A[18]
372        LET C[19,P]=C[19,P]+B[J]*A[19]
375        IF J<=12 GOTO  390
380        IF J<=24 GOTO  400
382        IF J<=36 GOTO  410
385        GOTO  410
390        LET T1=895.05
395        GOTO  450
400        LET T1=982.8
405        GOTO  450
410        LET T1=1016.4
415        IF K<2 GOTO  450
425        LET A[20]=B[J]*173.33*.0605*W1
430        GOTO  452
450        LET A[20]=B[J]*173.33*.0585*W1
452        LET U1=U1+A[20]
454        IF U1<=T1 GOTO  470
456        LET A[20]=A[20]-(U1-T1)
458        LET U1=T1
460        LET W1= 0
470        LET C[20,P]=C[20,P]+A[20]
480        LET A[21]=B[J]*173.33*.041*W2
482        LET U2=U2+A[21]
484        IF U2<=172.2 GOTO  510
486        LET A[21]=A[21]-(U2-172.2)
488        LET U2=172.2
500        LET W2= 0
510        LET C[21,P]=C[21,P]+A[21]
545        IF J=A[23]+A[24]-1 GOTO  570
555        IF J<N3 GOTO  620
570        IF U1= 0 GOTO  604
580        LET M=M+1
604        LET W1=1
606        LET W2=1
610        LET U1= 0
612        LET U2= 0
620      NEXT J
630    NEXT H
635    PRINT
700    PRINT "YEAR #";K+1
701    PRINT "NUMBER OF EMPLOYEES =";M;
702    PRINT "(NOT NECESSARILY ON PAYROLL ENTIRE YEAR)"
703    PRINT
704    PRINT "ACCOUNT";
705    PRINT  TAB 13;"1ST QTR"; TAB 25;"2ND QTR";
710    PRINT  TAB 37;"3RD QTR"; TAB 49;"4TH QTR";
715    PRINT  TAB 61;"TOTAL"
716    PRINT
900    FOR I=14 TO 21
905      GOSUB  4000
952      FOR J=1 TO 12 STEP 3
955        FOR P= 0 TO 2
960          LET D[J]=D[J]+C[I,J+P]
962          LET D[J]= INT (D[J]+.5)
965          LET E[J]=E[J]+C[I,J+P]
967          LET E[J]= INT (E[J]+.5)
970          LET F[I]=F[I]+C[I,J+P]
972          LET F[J]= INT (F[J]+.5)
975        NEXT P
985        GOSUB  1300
990        PRINT "$";D[J];
995        LET G1=G1+D[J]
1000        LET D[J]= 0
1005      NEXT J
1010      PRINT  TAB (Y+12);"$";G1
1015      LET G2=G2+G1
1020      LET G1= 0
1025      LET Y= 0
1030    NEXT I
1032    PRINT
1035    PRINT "TOTALS";
1040    FOR J=1 TO 12 STEP 3
1050      GOSUB  1300
1055      PRINT "$";E[J];
1057      LET E[J]= 0
1060    NEXT J
1070    PRINT  TAB (Y+12);"$";G2
1075    PRINT
1080    LET G3=G3+G2
1085    LET G2= 0
1087    LET Y= 0
1089    LET M= 0
1090  NEXT K
1091  FOR I=14 TO 21
1092    PRINT  TAB 5;"TOTAL COST OF ";
1093    GOSUB  4000
1094    PRINT  TAB 32;"$";F[I]
1095  NEXT I
1096  PRINT
1097  PRINT  TAB 5;"PROGRAM TOTAL"; TAB 32;"$";G3
1098  GOTO  9999
1100  FOR I=1 TO 25
1105    FOR P=1 TO 18
1110      LET C[I,P]= 0
1115    NEXT P
1120  NEXT I
1130  LET N8=N8+(S[K]+R[K])/100
1150  RETURN
1300  LET Y=Y+12
1305  PRINT  TAB Y;
1310  RETURN
2000  PRINT "TOTAL NUMBER OF EMPLOYEES";
2005  INPUT N4
2007  PRINT
2025  PRINT "EMPLOYEE #,";
2027  PRINT "ANNUAL SALARY $ ?, START MONTH # ?, MONTHS WORKED ?"
2028  PRINT
2030  FOR I=1 TO N4
2032    PRINT "EMPLOYEE #";I;
2040    INPUT A[25],A[23],A[24]
2042    PRINT
2043    LET L[I,23]=A[23]
2044    LET L[I,24]=A[24]
2045    LET L[I,25]=A[25]
2046    IF N6>(A[23]+A[24]-1) GOTO  2055
2050    LET N6=(A[23]+A[24]-1)
2055    LET N7= INT ((N6-1)/12)
2060  NEXT I
2065  RETURN
4000  IF I=14 GOTO  4030
4002  IF I=15 GOTO  4034
4004  IF I=16 GOTO  4038
4006  IF I=17 GOTO  4042
4008  IF I=18 GOTO  4046
4010  IF I=19 GOTO  4050
4012  IF I=20 GOTO  4054
4014  IF I=21 GOTO  4058
4016  RETURN
4030  PRINT "WAGES";
4032  RETURN
4034  PRINT "VACATIONS";
4036  RETURN
4038  PRINT "HOLIDAYS";
4040  RETURN
4042  PRINT "GROUP INS.";
4044  RETURN
4046  PRINT "SICKNESS";
4048  RETURN
4050  PRINT "OTHER ABS.";
4052  RETURN
4054  PRINT "F I C A";
4056  RETURN
4058  PRINT "UNEMPL. TAX";
4060  RETURN
9999  END
```

What If?

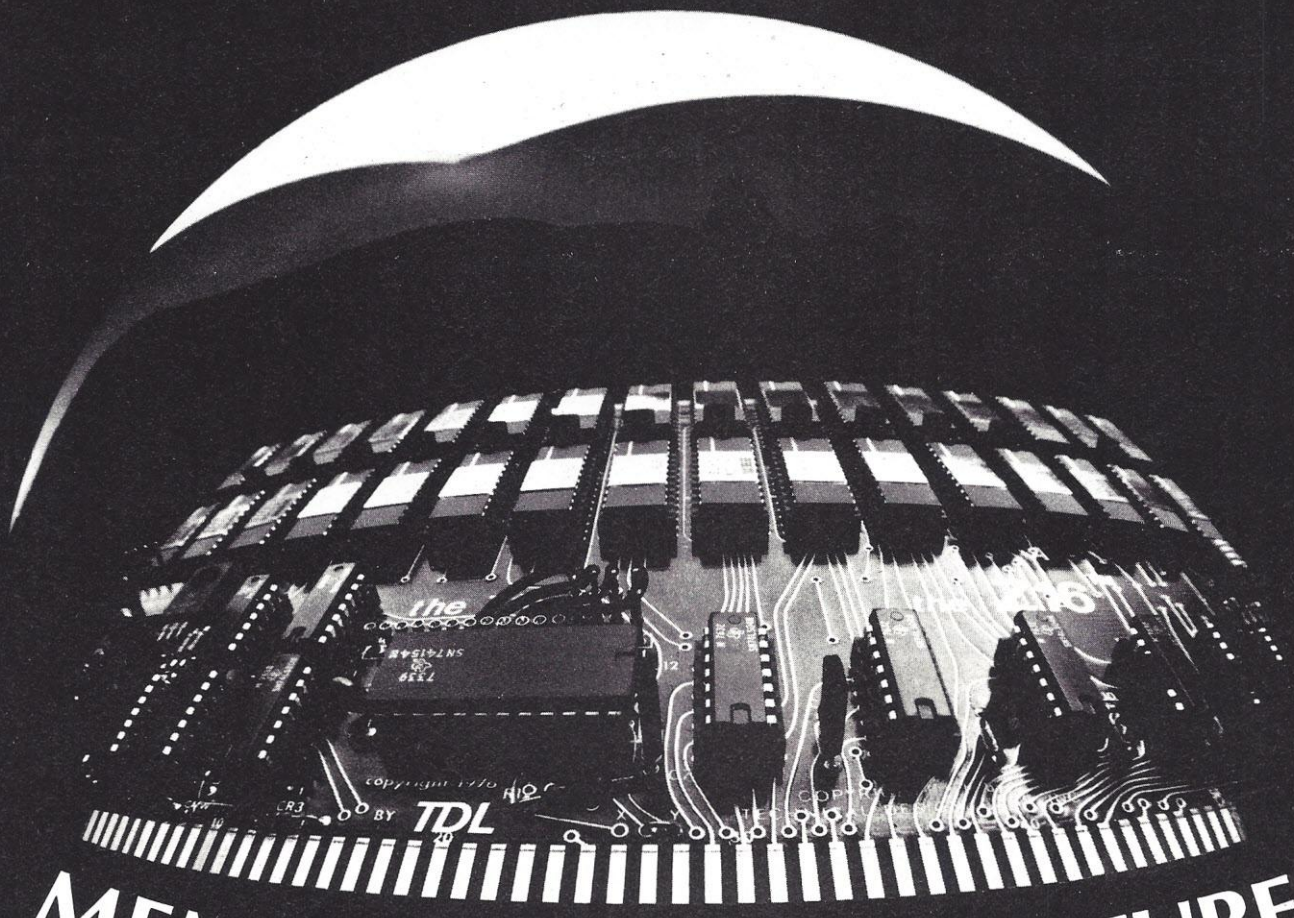
The computer's power is demonstrated in the last concern of this rough outline. The planner can play "What if?" What if the rate of inflation varies over the next three years for which this project is being laid out? What if tax rates are changed?

In this case, variables treating inflation, salary increases and tax rate changes were built into the program. Because the inflation rates are, of course, not reliably predictable, the planner cast around for reports on the opinions of experts in government and business and selected some likely numbers. For example, this particular run used inflation rates of 8.0% for the first year, 6.6% for the second, 5.1% for the third, 4.8% for the fourth, and 4.6% for the fifth year. (The computer program is written to accommodate projects of up to five years in duration.) Tax rates were also scaled according to laws Congress was passing. Salary merit increases were scaled at 5% a year.

But what if these values were changed? Without the computer, the recalculation to consider alternatives is a formidable task, but *with* the computer, it's work of a few minutes. The venturer can see the effects of alternative decisions.

We noted that labor is the biggest cost item in this project, as in most. That's a variable that may be changed from run to run. So the effect of hiring more or fewer people for extended or diminished periods of time can be seen very quickly.

It's this extremely fast re-work that makes the computer such a valuable tool for the project planner. He must do all of the standard original homework, make the difficult guesses and think about all of the unpleasant things, but once the material has been assembled, he can manipulate it in a hundred ways to pick the best probable course of action.



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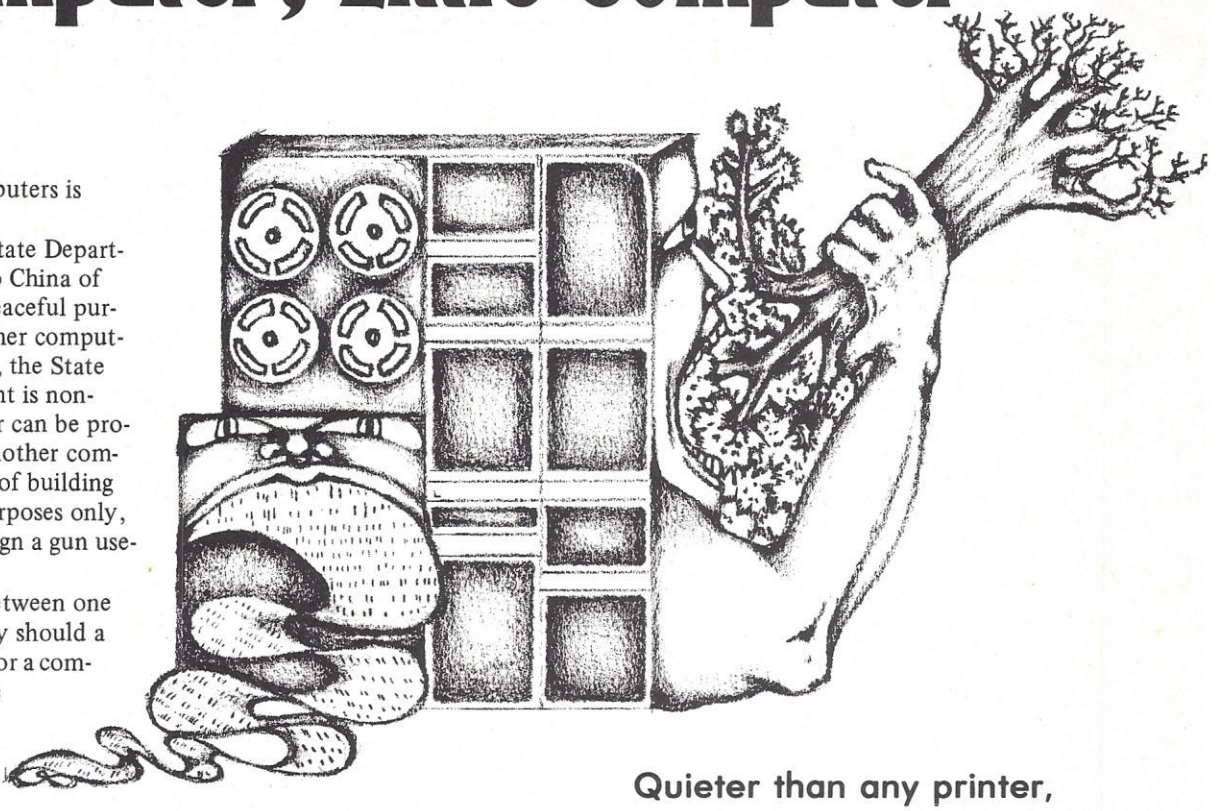
Big Computer, Little Computer

by Jeff Raskin



Distinguishing among computers is difficult.

A few months ago the State Department announced the sale to China of computers "designed for peaceful purposes". Regardless of whether computers should be sold to China, the State Department's announcement is nonsense. *Any* digital computer can be programmed to do *anything* another computer can. There is no way of building a computer for peaceful purposes only, any more than one can design a gun useful only for defense.

What is the difference between one computer and another? Why should a company spend $3 million for a computer when you can get one for a few hundred that can theoretically, do the same job? What do computer scientists mean when they claim that all computers are, in some precise sense, equivalent?

The equivalence of different computers can be seen from this example: If a large "fast" computer were running a problem in BASIC and a small "slow" home microcomputer were running the same program, their answers would be the same. Whatever languages are used, from machine language through the latest, most sophisticated super language and whatever computer is used – or even if the program is executed by hand – given the same algorithm and the same data they produce the same results.

Now, for some quibbles. I assumed the computers don't malfunction and the program does not depend on any "special property" of the computer. This opens up a box full of critters: What are the "special properties" of computers?

Speed

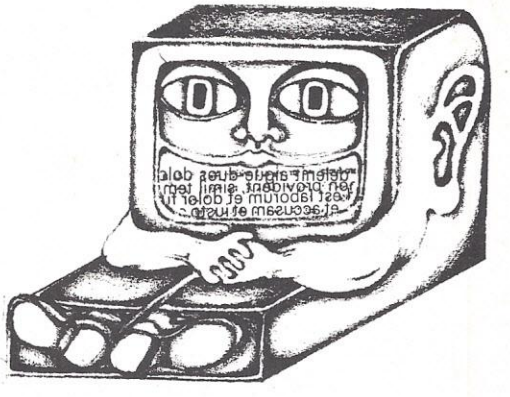
The first difference between computers that is usually mentioned is speed. The computer's inherent speed may have little relationship to the speed a human user perceives. For example, an inherently fast large computer may respond to your BASIC program more slowly than a microcomputer, if the large computer is timesharing and the microcomputer is yours alone.

No way of measuring inherent speed fits all applications. The parameter most often bandied is "cycle time." Another common weapon in bragging contests is "clock speed." For example, the Polymorphic Systems Poly 88 microcomputer uses a 16 megahertz clock (approximately) and the Imsai 8080 has a 2 megahertz clock. (A *megahertz* means a million cycles per second.) Does that make the Poly 88 eight times faster than the Imsai 8080? No, because the Poly 88 clock is divided by nine before the CPU uses it. The Poly runs about 8 percent slower.

But even the clock speed reaching the CPU doesn't tell how fast a job will get done. You must also ask *how many cycles* an operation requires. An 8080 CPU system with a clock frequency of two megahertz executes a program at about the same speed as a 6502 CPU system with a clock frequency of 1 megahertz, since the two chips use the clock differently.

A better prediction of how long a program will take is the "add time," the time the processor takes to add two one-word integers. But the add time is a fair measure of speed only if the application depends on how fast the computer can add. Although the speed of a mathematical program or engineering problem might depend on how fast the computer can add, a text-processing application might depend more on a machine where the time required to move a character from one memory location to another.

Quieter than any printer, and without the need to eat trees, are the CRT terminals



Word Length

Another difference between computers is their *word length.* Though some

experts may quibble, the word length of a computer is generally the number of bits the accumulator can hold. The Intel 8080, the M6800, the Z80, the MOS 6502 and most other home computers have a word length of eight bits.

An eight-bit word represents only 256 different integers. Thus, an eight-bit word might specify numbers from 0 to 255. Another possibility is to use the eight bits to represent numbers between -128 and +127. Any other set of 256 integers may be represented.

But eight bits of precision is not enough even to write a check-balancing program, unless your balance and checks range only from, say, 0 to 255 *cents*. So a machine with a small word length, called upon to work with high precision, must do its arithmetic piecemeal, a few digits at a time. Piecemeal arithmetic is called *multiple precision*. The special case where two machine words represent one number is called *double precision*. Altair BASIC uses four words to represent a number. Tiny BASICs commonly use two. For a given word size, the higher the precision the slower the program runs.

A checkbook program would need at least four eight-bit words to represent amounts from minus $20 million to plus $20 million without losing track of the pennies. To add two such amounts an eight-bit microcomputer must do four additions and bookkeeping to keep track of it. Even if the "add time" is 1 microsecond, it would take at least 4 microseconds to add two numbers for the checkbalancing program. If the computer had a 32-bit word and the same 1 microsecond add time it would *for this application* be at least four times faster.

But for processing characters, having a 32-bit word is *slower*. A 32-bit-word computer must pack four eight-bit characters into each 32 bit word, to conserve memory space. Many character-processing applications require the computer to search for a phrase to be edited and check every character. To dig a particular character out from the big word requires a shifting and possibly a masking operation, which takes time.

An eight bit-word computer stores each character in a separate word that can be accessed directly without wasting time or storage. For this application the eight-bit word computer might well be faster than its 32-bit counterpart.

MAXIS VS. MINIS VS. MICROS

Maxicomputer, minicomputer, microcomputer — what's the difference? Here are some guidelines.

- **Size** of the total system. If it requires a large room, it's a maxi. If it fits in a corner, it's a mini. If it fits on a desk, it's a micro.
- **Price** of the total system, including even the peripherals and I/O. If it costs at least $170,000, it's a maxi. If it costs less than $12,000, it's a micro. Otherwise, it's a mini.
- **What the system resembles.** If it competes against an IBM/360 or IBM/370, it's a maxi. If it competes against a PDP-11 or IBM System/3, it's a mini. If against an Altair 8800 or IBM 5100, it's a micro.
- **Arithmetic** done by CPU hardware, instead of by software. If the hardware only adds and subtracts short integers (at most 16 bits), it's a micro. If it adds, subtracts, multiplies and divides long integers (at least 32 bits) and very long floating-point numbers (at least 64 bits), it's a maxi. Anything between is a mini.
- **Languages** the computer understands. If almost solely assembler and BASIC, it's a micro. If offering alternatives also (RPG, Focal, or subsets of COBOL and FORTRAN), it's a mini. If the computer is intended *mainly* for COBOL, FORTRAN, or PL/I, it's a maxi.
- **Data bus**, which sends data to and from the CPU. Find out the data bus's *width* (how many bits the bus transmits in parallel). If the width is at least 32, it's a maxi. If between 24 and 12, it's a mini. If 8 or 4, it's a micro.
- **CPU's appearance.** The CPU is a micro if it lies on a single chip. If multi-chip, it's a mini or maxi.
- **How many users** the operating system handles simultaneously. If it handles just one, it's not a maxi. If it handles many, it's not a micro.
- **How many memory addresses** the CPU accesses directly, without using page flags or memory-management modules. If it accesses at least 2^{18} addresses directly, it's a maxi. If it accesses at most 2^{16}, it's a mini or micro.

For peculiar machines such as the PDP-8 Classic, the LSI-11, the PDP-11/70 and the IBM System/32, those definitions contradict each other.

Peripherals

Peripheral devices (which include keyboards, printers, CRT terminals, Teletypes, tape readers and punches, cassette interfaces, and disks) do not affect the speed of the CPU. But they affect the speed of your program, especially if the program uses them heavily.

From the point of view of the CPU, even memory is peripheral. Any instruction that stores or fetches something from memory depends on the memory's speed. Since faster memory costs more, the best choice is to purchase memory just fast enough so that the CPU doesn't have to wait. Faster memory would waste money, since it would be waiting for the CPU.

In the early days of home computing

From the point of view of the CPU, even memory is peripheral.

(all of a year or so ago!) some memory did slow down the CPU. Rapidly dropping prices on fast memory have eased the problem, but memory fast enough to run an 8080 or 6502 at full speed is not fast enough for newer processors, such as the Z-80.

Memory's speed often counts less than other peripherals'. A slow memory that makes your program execute in 5 seconds instead of 2 seconds is still adequate, if reading the program into the computer from paper tape on a Teletype takes six *minutes.* The speed of a program that prints massive charts or plays fancy games depends mostly on the printer; the CPU clock and memory speeds are almost irrelevant. The speed of a text-editing system depends mostly on your fingers; compared to even the slowest computer, they are insufferably slow at typing. Again we find *the power of a computer depends heavily on the application.* Computer buyers who do not understand this keep a number of computer salesmen well fed (and overdressed). Originally the computer itself was the most expensive part of the system but now the cost of peripherals usually far exceeds the cost of the computer. (Computer and peripheral costs are rapidly being eclipsed by the cost of software, but I guess that's off the topic). Another difference between computers is the selection of peripherals they can handle, although this distinction is disappearing. At the present time the microcomputers can handle small and medium size disks but don't yet have the speed to handle the largest and fastest disk systems. Compared to the cost of a microcomputer, large disk systems are extremely expensive – in the high tens of thousands of dollars. Microcomputers can handle any of the cassette or cartridge tape drives and most traditional tape drives as well, though the large reel-to-reel tape drives that so often appear on television whenever computers are mentioned lie outside the typical personal computer system budget.

The prospective owner of a home computer system might do well to ignore the burning question of which computer to buy and concentrate on choosing peripheral devices. The peripherals are what the buyer will most often see and touch. They will cause most of the problems and cost the most money.

Peripherals can be arranged in order

Too often the urge is only part of the "fastest, bestest" syndrome.

of speed, usually measured in the number of bytes that can be transferred in one second. The *baud rate* of such a device is the number of bits per second, which is eight times the number of bytes per second. The price of a device tends

to be proportional to the speed. For disks and other fast devices, the price also depends on the amount of storage, which is measured in bytes.

Though a Teletype's paper tape can store any number of bytes, storage and handling of very large amounts of data on paper tape can be awkward. Cassette tapes pack the data more densely and are easier to handle. They range from about 30 bytes per second to 200 bytes per second. Special cartridge drives and custom cassette drives go even faster.

Disk systems range upwards from cassette speeds; the most expensive ones on large computers can transfer 3,000,000 bytes per second.

The lowly Teletype prints at 10 characters (bytes) per second. The popular Decwriter and daisywheel printers print 30 to 60 characters per second. Dot matrix printers are in the same speed range, along with most of the thermal printers. Price depends on both speed and print quality. You can buy a Decwriter, with mediocre computery appearance, for about $1500. Daisywheel printers such as the Qume and Diablo mechanisms have much better print quality, but a complete terminal costs about twice as much as the Decwriter. Thermal printers, like the Teletype, generate output that is not much to look at. IBM Selectric typewriters print no faster than 15 characters per second and are difficult to interface. Faster printed output is available from devices called line printers that range up to 30,000 characters per second and $100,000 price tags, and are intended to spew forth more paper than you'd want in your home.

Quieter than any printer, and without the need to eat trees, are the CRT terminals. Even the cheapest (of which the best-known is the Lear-Siegler ADM-3) can run at nearly 2000 bytes per second. With well designed software, hard copy is seldom necessary in a personal computer system, since data can often be stored on tape and brought up on the CRT when needed. CRT terminals start at $250 (for a video board and a monitor) and go up. Here more money usually buys little more basic performance.

Why should a company spend $3 million for a computer when you can get one for a few hundred that can, theoretically, do the same job?

There are many other types of peripherals. Often the difference between a big computer system and a little one is merely how many peripherals have been hung on and how much they cost.

Many personal system users want to "step up" to a faster CPU. Few of them need it. Too often the urge is only part of the "fastest, bestest" syndrome. Home computers are more often bragged about than used. A computer's usefulness depends more on its peripherals than on its CPU.

Memory Size

Another difference between small and large computers is the amount of memory the CPU can address.

If the personal byte size-word computer allowed memory locations to be specified in only one word, the computer could address only 256 memory locations. Since 256 locations would provide a very small computer memory indeed, byte size-word computers use two words to address memory. This allows 65,636 locations of memory. (This amount of memory is usually called 65K. The K stands for some number near one thousand. The exact number is not clear. When talking about an 8K memory, K means 1024. But in a 65K memory K seems to be a bit higher than 1008.25. Don't worry about it.)

Since a computer can be designed with any number of words to an address,

word size does not limit the amount of memory that can be addressed. But word size combined with the structure of the instruction set (the *architecture* of the computer is the usual term) determines the largest memory size directly addressable. Since processing a multiple word address usually takes longer than a single word address, a machine with a larger, word size tends to be faster when dealing with large memories.

If a computer can be made to go only so fast then maybe two can split the work between them and do it twice as fast.

Aside from multiple word addresses, there are other tricks a small computer can use to address large memories. But each method costs time. One such method is to use an output port to specify which of 256 banks of memory is being addressed; each bank can contain 65K locations, making a grand total of 16,770,216 words of memory. At present prices of about $100 for 4K and allowing for quantity discounts, that much memory would cost nearly a quarter of a million dollars. Each time the program switches memory banks it would have to give an output instruction, which takes time. Switching between banks is called *paging* (though on large computers, paging means something different). With a suitable application and good programming the switching need not be frequent. Come to think of it, I doubt anyone will attach that much memory to a home microcomputer. To reference a large memory at widely varying locations *quickly* requires a computer having a large word. Otherwise a micro's okay.

Parallel Processing

If a computer can be made to go only so fast, maybe two can split the work between them and do it twice as fast. Why not four, or even 64 computers, for that matter, all sharing the load? When a number of computers work on different parts *of the same problem* at the same time, you have a situation called *parallel processing.* (If one computer is running BASIC while another controls the printer, they are *not* parallel processors, since they are doing different tasks.)

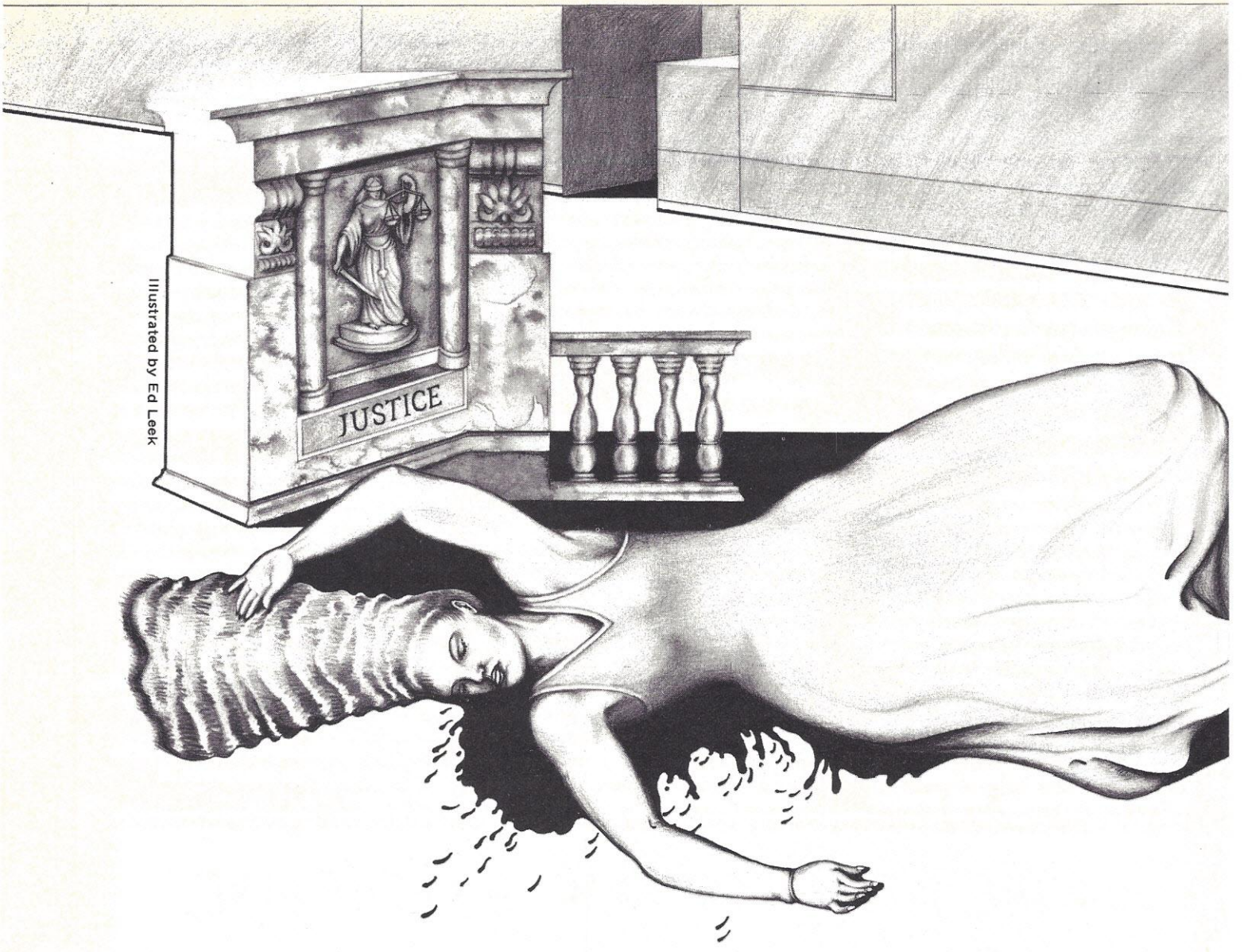
Though building parallel machines for home use is not difficult, writing the software is. Parallel computers handle only a few problems efficiently: meteorological problems, others involving large matrices, pattern recognition, and some problems in graphics. Parallel processing is not the kind of thing you can do casually, so it is not likely to be an important factor in home computing.

And in Summary . . .

The differences between computers *per se* lie in their speed of executing instructions, their architecture, word size, and ability to handle the different classes of peripherals. Extrinsic differences are software available, cost and service support. The choice of a computer depends on the application. A computer's effectiveness and cost usually depend more on the peripherals than on the CPU.

One point hasn't yet been mentioned: the quality of the software can make an otherwise excellent system seem bad, or a marginal one seem good. A poorly written program on the fastest machine can make it seem slow. On the other hand, clever and careful programming of a small machine can give results all out of proportion to the miniscule cost of such a system. Lastly, poor documentation can make the best of systems unusable.

Big Computer, Little Computer, take your pick. Let your application be your guide.



Illustrated by Ed Leek

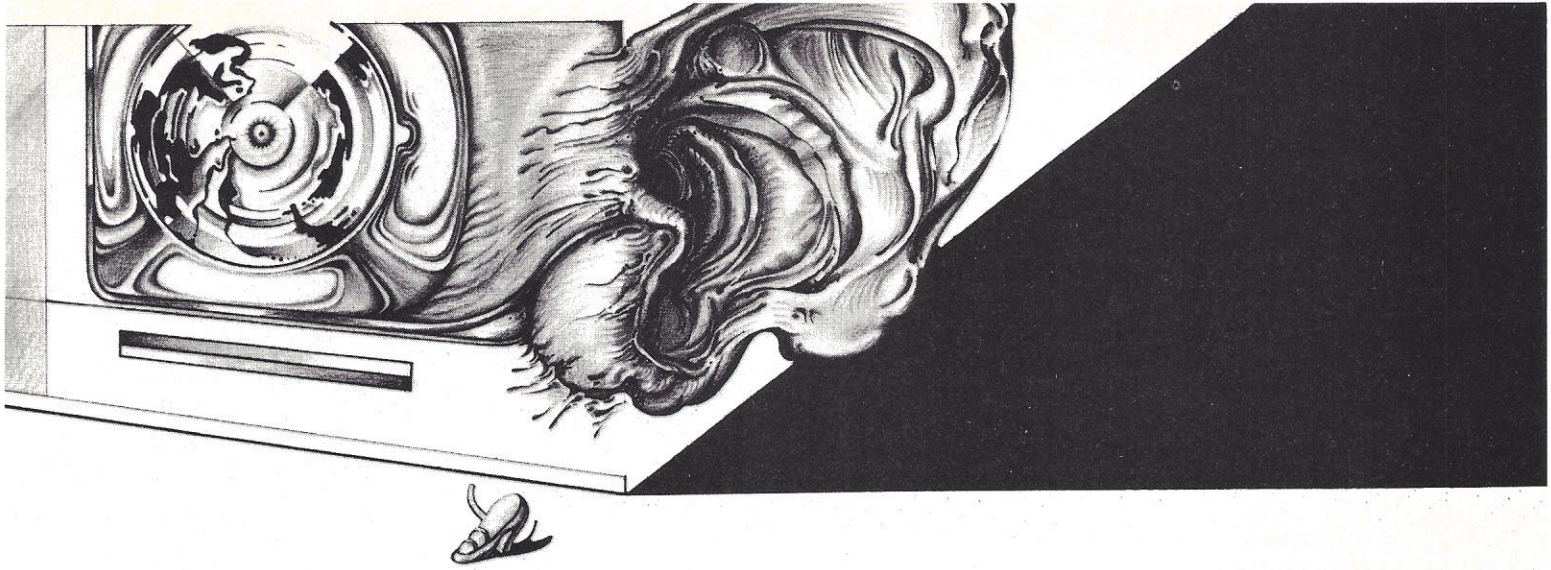
WHEELS OF JUSTICE

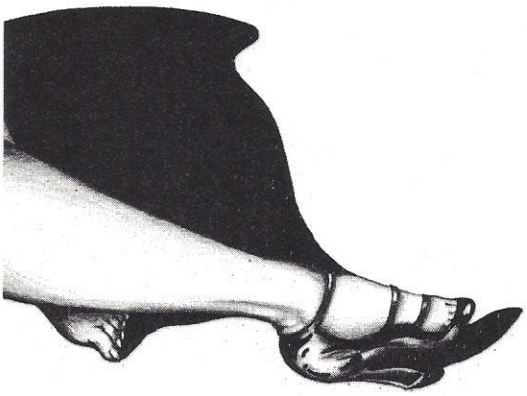
Has the law a necessary connection with justice . . .
. . . or justice with truth? Certainly fair is fair!

fiction by David Galef

CONLAW was an amalgamation of the finest legal minds of the century with a file of all the legal precedents of the past 500 years. Completely impartial, CONLAW could argue a case for prosecution or defense and act as presiding judge and jury —all in the same case. The computer complex that was CONLAW occupied the entire first floor of City Hall. Fifty years earlier before the advent of molecular storage techniques, a computer the equal of CONLAW would have taken up an entire city block, even supposing that such a level of sophistication in computing could have been attained. In short, CONLAW represented the acme of computer technology, the latest offshoot of the Artificial Intelligence Institute, an organization started at the Massachusetts Institute of Technology in the mid-twentieth century.

The moment the last adjustment was made on CONLAW, the moment the last Dirksen tube was put into place, CONLAW was put to use. The facts in a traffic violation case were fed into the hopper, and CONLAW delivered a verdict in less than half a minute: guilty. Satisfied that the computer could handle minor violations and petty grievances, the authorities then had CONLAW decide on seven breach of the peace cases, two grand larceny charges and three paternity suits. In each case, CONLAW considered the data input, occasionally posing a question to the data technicians, then delivered a verdict. CONLAW behaved just as expected, meting out the proper acquittals and punishments. A channel was then opened between the enormous backlog file of cases pending and the spacious storage facilities in CONLAW's memory banks. CONLAW began hearing cases 24 hours a day, dealing out justice every day of the week except Sunday, when the courts were officially closed. CONLAW was a resounding success — a triumph of technology over the hopelessly outdated legal





system of the era.

The surface of CONLAW was painted an unappealing gray to uphold the dignity of the court. The one break in the monotony of metallic gray occurred at a fusion corner near the left storage bank, where the computer was fitted out with a graphic sophisticated sensory apparatus, colored in flesh-tone, enabling it to perceive graduations in light and sound. The fact that CONLAW could see and hear better than a human being was considered immaterial; the sensory apparatus was introduced merely as one of those anthropomorphic touches computer technicians are so fond of adding, such as calling an ALpha Interactive Computing Environment ALICE. CONLAW, however, was too massive a machine to be given any flip acronyms. Any machine with the power to mete out death sentences is simply not funny, not by any stretch of the imagination, and the rash technician who ventured to call the system CONNIE was fired on the spot.

On October 23, A.D. 2082, at 0900:00 precisely, CONLAW was deciding upon a lengthy divorce case. As prosecutor, CONLAW had evolved a rather brilliant line of legal reasoning based on the assumption that grounds for divorce could include failure to smile at one's mate over the breakfast table, thus establishing the proper definition for an alienation of affection case. The defense, however, advancing the argument that breakfast smiles were nowhere to be found in the statute book, was also making headway.

The jury was waiting for the honorable defense to finish its closing speech, so it could decide. The judge was deliberating. The only sound on the first floor of City Hall was the soft hum of CONLAW. That was because the only functioning unit in the court, human or otherwise, was CONLAW, taking all the parts in the case like the impersonator in a one-man show in Vaudeville, circa A.D. 1900. Each role was kept strictly separate from the others, and impartiality was maintained as only a computer can maintain it.

The defense finished its final statement to the jury and was erased; so, too, was the prosecution. They had never really existed anyway, save as personifications in the storage facilities of CONLAW's right bank. The 12 components in the hindmost Kleindienst circuit were just approaching a verdict when CONLAW, in the capacity of a computer equipped with sensory apparatus, heard a scream. Widening its sensors to high range, CONLAW opened a simple mnemonic cell and started recording.

The man, the assailant, was repeatedly stabbing a knife, potential exhibit A, into the vitals of a struggling young lady, who would soon form the basis for a *corpus delecti*. The jury in the divorce court was announcing its verdict just as the young lady collapsed onto the floor in a pool of blood. The man walked quietly away, pausing only to throw the knife into a waste bin to the right of CONLAW's bottommost capacitor. Seeing that no further action would take place, CONLAW dimmed its sensors back to low range and proceeded with the next case on the docket.

The body was discovered at 1300:53 on October 24, A.D. 2082, by a computer technician who had come in to give the machine its weekly spotcheck. Upon seeing the body lying in its pool of blood, now a red, stiff puddle, the technician let out a circuit-curdling scream and fainted. When the technician recovered, after what seemed to him several hours (actual elapsed time, as recorded by CONLAW was 3:28 minutes), he looked around, shuddering violently at the sight of the awful corpse. He ran to call the authorities just as CONLAW was passing judgment on a speeding ticket.

Three men in sanitary white suits soon arrived and took care of the body while jotting down notes on little white pads. CONLAW kept functioning smoothly, refusing in a petty lar-

ceny case to input the suggestions of an *amicus curiae.* Justice must be upheld in the most literal way possible, and a computer has no friends. CONLAW continued to grind out decisions for 400.56823+ days, Sundays not included.

It was well over a year before the murder charge against Frederick Danton was brought to the attention of CONLAW: State v. Danton, Danton being accused of the willful murder of one female, still unidentified.

The evidence was entirely circumstantial. Danton had been seen and positively identified at around the estimated time of death walking away from City Hall rather hurriedly, with a worried expression on his face — so claimed the witness who had made the identification. A knife found in a waste bin at the scene of the crime was of no help at all; there were no prints on it. Danton was merely the most probable suspect; the question of motive was still puzzling.

Though the prosecution's case was shaky at best, the point made was valid: no one except the defendant had been seen around the area of the murder at that particular time. The defense waived away the allegation with disavowals. The fact that no one else had been seen around the area was pitifully little evidence upon which to base a murder charge; there was no motive, no real witnesses, and therefore no case. The prosecution forwarded the argument that the question of motive was left unanswered only because the female (deceased) was still unidentified. Motive, insisted the defense, was nonetheless left unestablished. The defense knew when it stood on solid ground; it insisted that the charge be dropped.

The 12 components in the Kleindienst circuit recorded the proceedings, missing nothing. The judicial drama moved systematically forward as it should, disturbed not at all by a trifle of noise that occurred in one circuit. A mnemonic cell, untapped for well over a year, was addressed suddenly by a chance combination of vaguely related data flowing through CONLAW. It opened and flashed to CONLAW's monitor the image of a man, bent in fury, repeatedly plunging a knife into a struggling female. The blood ran red on the floor and the face of the man was the face of Danton. The image vanished as the monitor cleansed this aberration from the system. The trial continued.

The prosecutor's case became progressively weaker; no solid evidence was available. The closing speeches of both sides were soon over and the jury components began the act of deliberation. The case appeared quite simple: the suspect Danton could not be convicted because of insufficient evidence; therefore, not guilty. That was the verdict the jury brought forth.

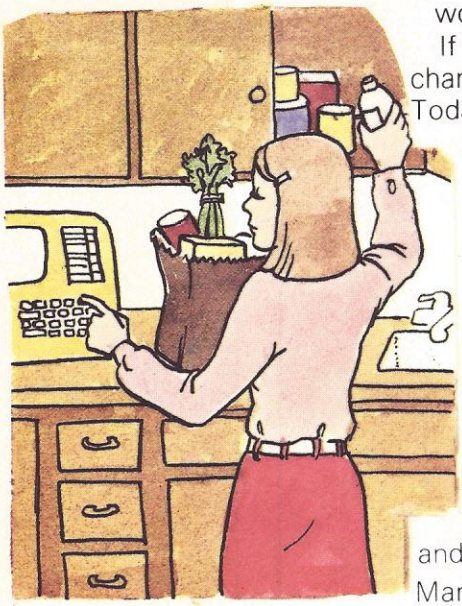
CONLAW sent through the verdict on the electrostatic teletypewriter, as it had with the millions of other cases it had decided, then it went on to the next case. There was no question of a miscarriage of justice; perfect impartiality had been maintained. The fact that CONLAW knew the murderer to be one Frederick Danton, as identified beyond the shadow of a doubt by the flawless sensors of CONLAW, was certainly immaterial. The information was not introduced during the course of the trial, and the decision made was based on the evidence available. The information that would reveal the murderer remained forever sealed in mnemonic cell # 40,531 of CONLAW's left memory bank, subject to instant recall.... but who would ask CONLAW to recall information that no one knew it possessed?

Personal Computing

...an idea whose time has come!

PERSONAL COMPUTING is an exciting new magazine about revolutionary developments in personal computers. Designed around miniature IC chips, these computers are now being sold through retail stores at about the price of a home stereo system. Experts project that over 1,000,000 personal computers will be sold in the next five years.

The impact of personal computers will be enormous. It is the job of PERSONAL COMPUTING to make certain you know what computers are, how they work, and in what ways they are changing the world around you.

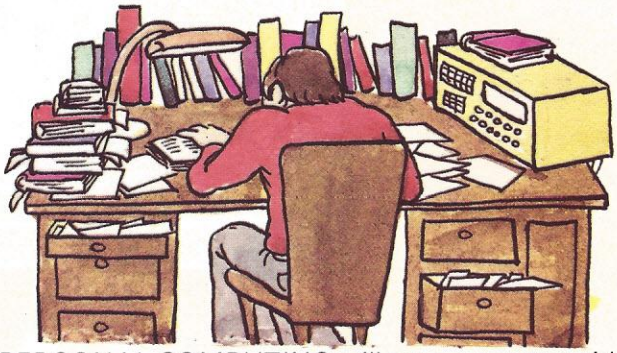


If you don't have your own computer by now, chances are there's one in your immediate future. Today's personal computers can do the following tasks:

Family and personal business management
Teaching aid for you and your children
Robot and industrial control
Inventory management
Accounting
Figure income taxes
Sophisticated text editing
Immediate access to files of information
Monitor and control energy consumption
Computer games including pong, chess and Startrek
Store and alphabetize addresses and phone numbers

and much more. New applications are appearing daily. Many of them are featured in PERSONAL COMPUTING.

PERSONAL COMPUTING wants to reassure you about the ease with which you can master your own computer. Each issue contains easy-to-follow, nontechnical articles on computer programming and computer jargon. These articles illustrate the use of personal computers at home, school, and work.



PERSONAL COMPUTING will serve as your guide into this exciting technology. We'll provide you with all the up-to-date information on new computer products, computer clubs, computer retail stores, and important personal computing events. PERSONAL COMPUTING will help you find the right computer system and the right software for your own, special application.

Each issue of PERSONAL COMPUTING contains the following:

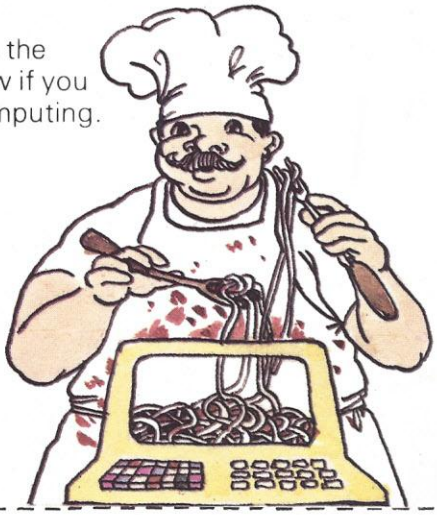
- **Lemonade Computer Service Company** section dedicated to the profitable uses of personal computers. We'll show you how to use computers in your own business and include free program listings to help you along.

- **Future Computing** narrative that speculates on the future developments and uses of personal computers. Each issue we invite a knowledgeable personal computing figure to write this column, thus giving you a wide spectrum of interesting and oftentimes controversial views.

- **Interview** with prominent person who may influence the growth and development of personal computing. Those already interviewed include Donn Parker, the nation's leading expert on computer crime, and Jules Bergman, science editor of ABC News.

- *Free, full color computer art print*, suitable for framing.

- Special **Microtrek** section containing the technical information you'll need to know if you wish to get into the nuts and bolts of computing.



- **Spaghetti BASIC** programming course based on the proposition that learning to use a computer is as easy as learning how to make spaghetti.

- *Exciting computer games* including Hamarabi, Startrek and Backgammon are explained and free program listing provided.

In addition to these regular features, PERSONAL COMPUTING brings you news and stories from around the computing world. Our professional staff strives to bring you the best possible variety of articles, written in a fresh, lively style that you can easily understand.

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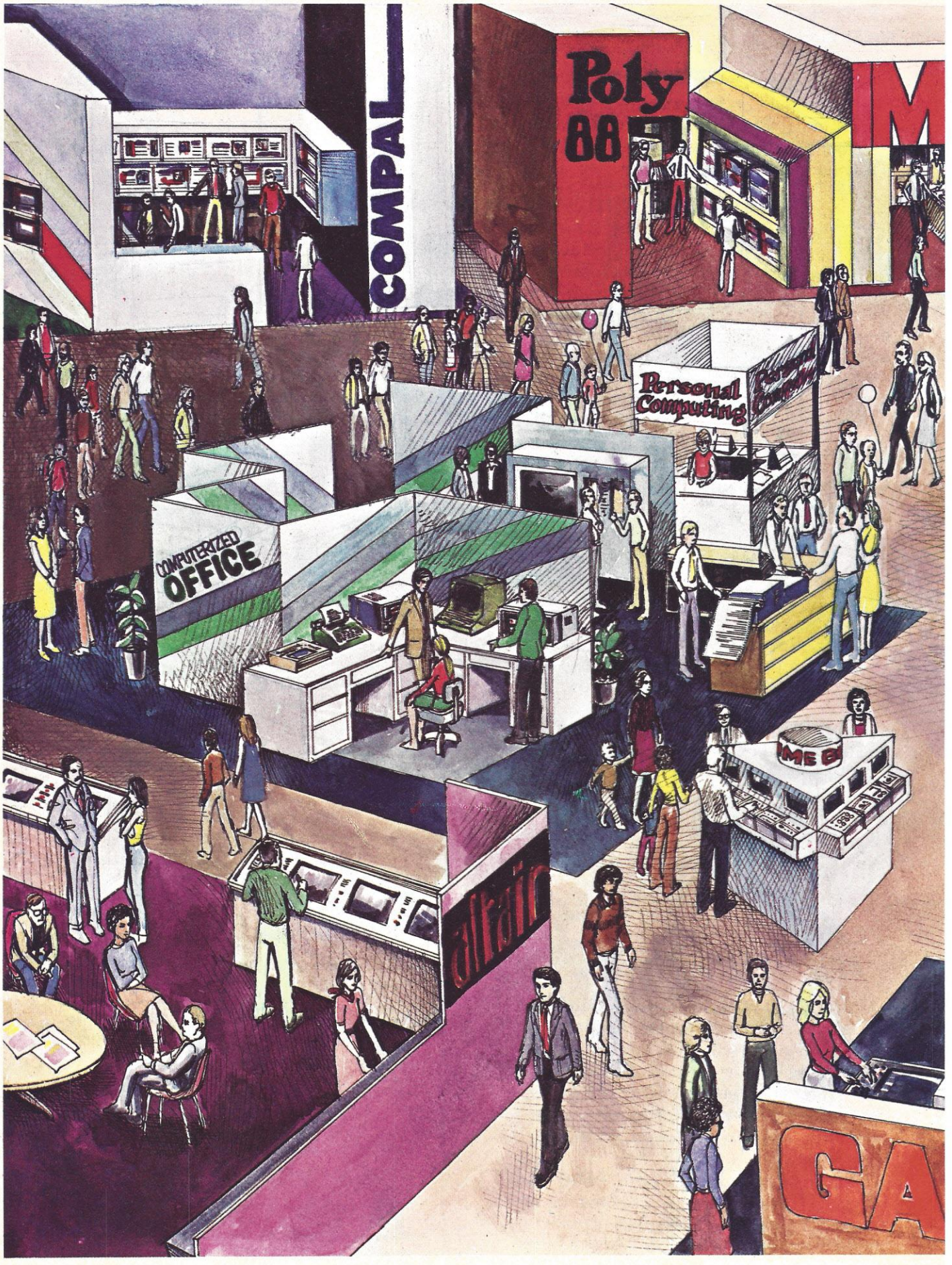
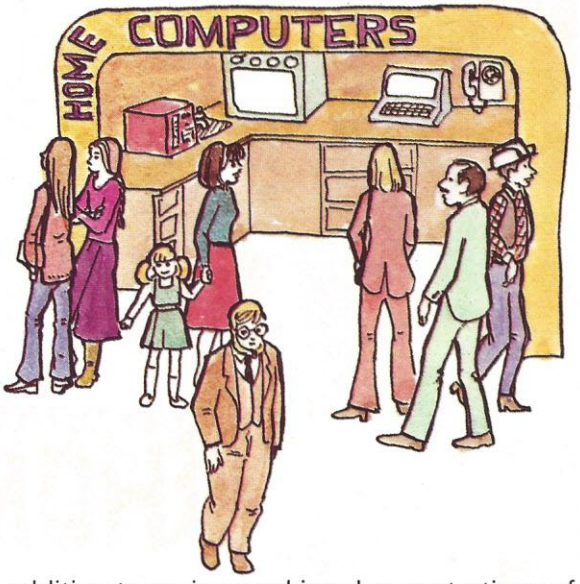


Plan On Attending A Regional

Artist's conception

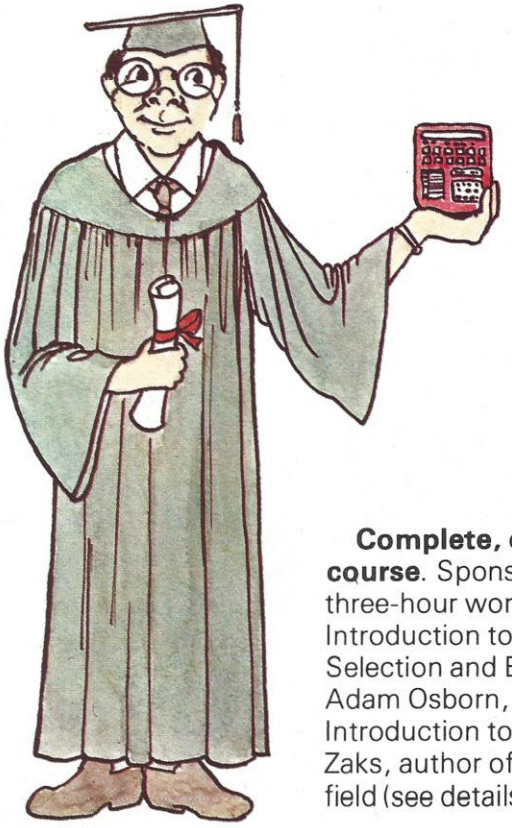
Personal Computing Show

The Excitement of Personal Computing



Learn all about the excitement of personal computing by attending one of the regional Personal Computing Shows. Sponsored by Personal Computing magazine, these shows feature exhibits of personal computers for the home, small business, and school.

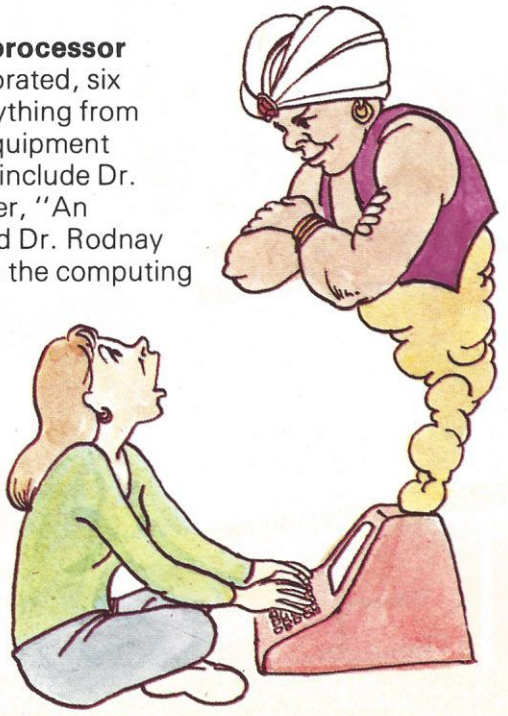
The excitement of the first *Western Personal Computing Show* is coming to **Los Angeles** on the weekend of **March 19-20** at the International Hyatt House near the airport. On the weekend of **May 28-29,** the first *Eastern Personal Computing Show* will be held in **Philadelphia** at the Marriot Hotel at City Line. Then, on **June 18-19**, the first *New England Personal Computing Show* will be held at Hynes Auditorium in **Boston.**



In addition to seeing working demonstrations of many fine computer systems, you'll also benefit from the many workshops, seminars, and special programs that have been scheduled. These include:

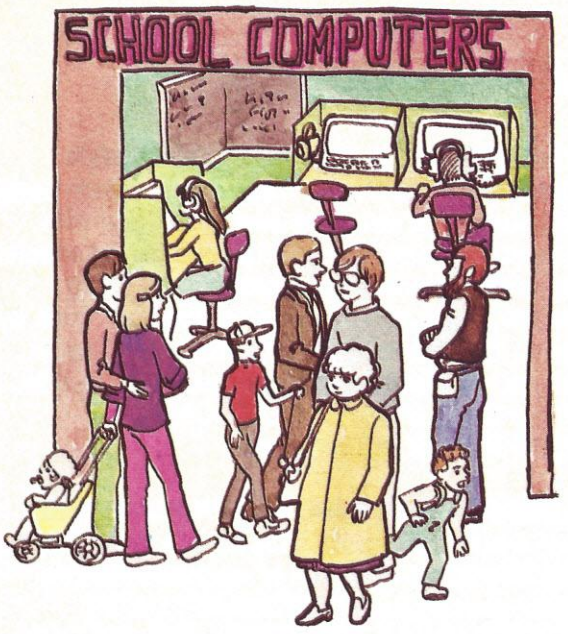
Special meeting of the Southern California Computer Society. Learn all about this dynamic organization whose 10,000 plus members are in every state and many foreign nations. Scheduled speaker in Los Angeles is Donn Parker, nation's expert on computer crime who was interviewed in the January/February issue of PERSONAL COMPUTING. Also scheduled is a panel discussion on the LSI-11 microcomputer. Saturday afternoon (admission free).

Complete, concentrated microprocessor course. Sponsored by Sybex Incorporated, six three-hour workshops will cover everything from Introduction to Microprocessors to Equipment Selection and Evaluation. Instructors include Dr. Adam Osborn, author of the best-seller, "An Introduction to Microcomputers", and Dr. Rodnay Zaks, author of more than 30 books in the computing field (see details in this ad).



The Personal Genie—A Guide to Personal Computer Programming. Conducted by Tom Munnecke, President of Metasystems in Riverside, California, three two-hour seminars will be presented each day of the show. Aimed at beginners who want to make their personal computers useful, these seminars include:

1. The need for software and types of personal software. Topics covered include languages (compilers, interpreters, and assemblers) and operating systems (program management, file management, resource management, text editors/



REGISTER NOW AND SAVE!

Yes, I would like to take advantage of your special, pre-registration rates. I plan to attend the following regional Personal Computing Show(s):

☐ **Los Angeles**
☐ Show (two days)
☐ One Day Pass Only

☐ **Philadelphia**
☐ Show (two days)
☐ One day pass

☐ **Boston**
☐ Show (two days)
☐ One day pass

Cost of Registration:
At the door:
$10 per show (two days)
$ 6 per One Day Pass
Special Pre-Registration Rates:
$ 7.50 per show (two days)
$ 4.00 per One Day Pass

Enclosed is a check for _____

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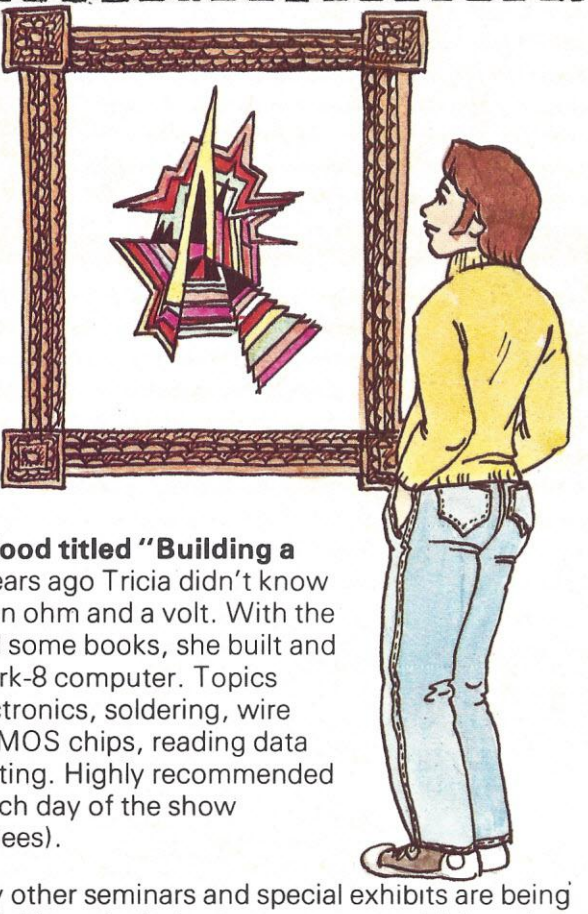
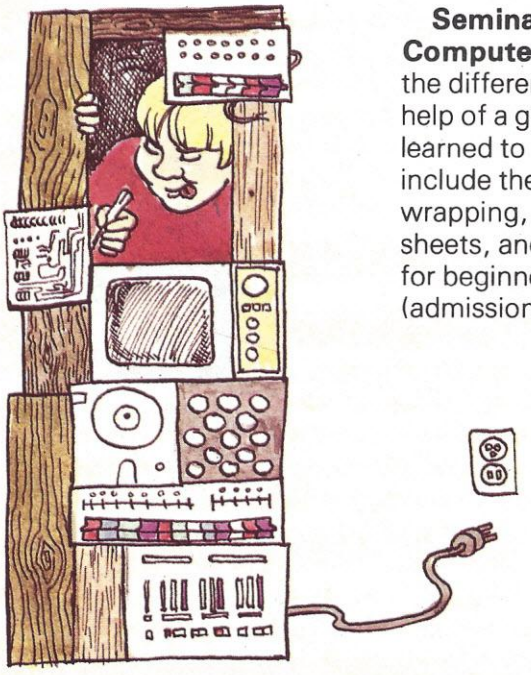
Send to: **Personal Computing**, Conference & Exposition Management Co., Box 844, Greenwich, CT 06830.

macro processors and monitors/executives). 10 a.m., each day of the show (admission free to attendees).

2. Comparison of microcomputer software describing each of the major languages with a sample program for each. Languages covered include BASIC, PL/M, FOCAL, FORTRAN, micro FORTH, APL, MUMPS, PASCAL, and ASSEMBLER. Operating Systems will also be covered, including FDOS (icom), ISIS (Intel), and ALS-8 (Processor Technology). 1 p.m., each day of the show (admission free to attendees).

3. Intensive seminar in programming BASIC. 6 p.m., each day of the show (admission free to attendees).





Seminar by Tricia Wood titled "Building a Computer Kit". Two years ago Tricia didn't know the difference between an ohm and a volt. With the help of a good friend and some books, she built and learned to maintain a Mark-8 computer. Topics include the basics of electronics, soldering, wire wrapping, tools, care of MOS chips, reading data sheets, and trouble shooting. Highly recommended for beginners. 3 p.m., each day of the show (admission free to attendees).

Many other seminars and special exhibits are being planned. These include a computer art exhibit and an exhibit of hobbyist computer systems. Door prizes worth hundreds of dollars are also being given away.

Personal computing is truly an idea whose time has come. Register now for the Personal Computing Show in your area and save over the cost of registering at the door.

SPECIAL MICROPROCESSOR COURSE

While in Los Angeles, Philadelphia, or Boston for one of the regional Personal Computing Shows, plan on attending a special, intensive Microprocessor Course. Sponsored by the professionals at Sybex, Incorporated, six intensive courses are being offered during the two days of the show. These courses include:

S1. INTRODUCTION TO MICROPROCESSORS. Scheduled for 9 a.m. to 12 noon on Saturday, this workshop is intended for all non-specialists who wish to acquire a broad understanding of the basic concepts and advantages of microprocessors. It explains how microprocessors work and it stresses methods, costs, advantages and disadvantages for the most important application areas of each type of microprocessor. What is needed to implement a system; how to use it; the impact of microprocessor-based systems; their evolution. Topics covered include: BASIC DEFINITIONS, SYSTEM COMPONENTS, MICROPROCESSOR APPLICATIONS, WHAT TO LOOK FOR, and IMPACT AND EVALUATION.

S2. PROGRAMMING MICROPROCESSORS. Scheduled for 1 p.m. to 4 p.m., this course describes the internal operation of a microprocessor system including how instructions are fetched and executed, how programs are written and executed in typical cases (arithmetic and input-output). The goal of this course is to provide an overall understanding of the basic concepts of microprocessor programming. Requires an understanding of the main concepts in the INTRODUCTION TO MICROPROCESSORS course. It is recommended that these two seminars be taken together.

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S4. MICROPROCESSOR APPLICATIONS. Sunday, 9 a.m. to 12 p.m. This course describes the main application techniques of microprocessors. Topics covered include INTRODUCTION TO MICROPROCESSOR SYSTEMS, APPLICATION TECHNIQUES, CASE STUDIES (Industrial applications, medical and business applications, microprocessors in the home, and others), and EVOLUTION.

S5. EQUIPMENT SELECTION AND EVALUATION. Sunday, 1 p.m. to 4 p.m. How to make a choice in the component and system jungle. Basic criteria and possible trade-offs. Areas of applicability for classes of products. This seminar lays down the guiding principles to select components and modules in function of user-defined criteria: performance, speed, ease of use, obsolescence, other contraints.

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ALL DRESSED UP
WITH A PLACE TO GO

by Henry Gilroy

Imagine that you have gathered all the elements you need to plunge into a computer project that may entertain you for the next decade. Components, boxes, manuals and tools are stacked behind a chair in your room, waiting for the first free hours you can spend assembling things.

Now the time comes: you can begin – if the people you live with will let you. As soon as you spread paper, wires, pencil stubs, coffee cups, bottles, equipment and maybe silvery bits of solder all over the area in which you work, the others in the house will complain. You will lose every argument over a disputed site.

No, you don't really want to drag your teletypewriter and computer into a damp corner of the basement or into a garage, where the temperature varies over an enormous range and the wind blows into your equipment through the cracks around the big door. The kitchen table puts you in the way, and people keep setting wet milk cartons down on your papers to remind you. There's no room in the bedroom.

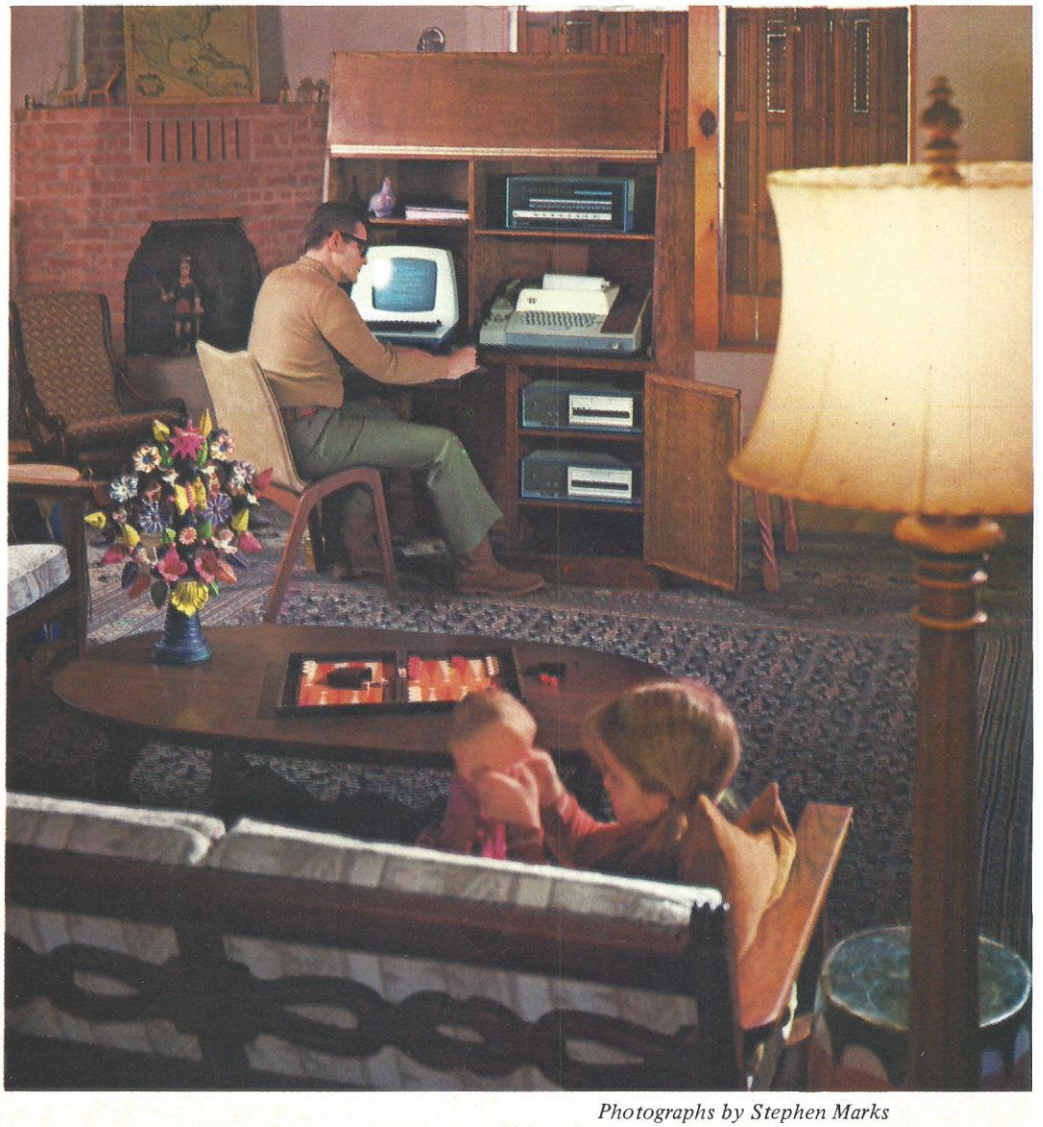
In fact, you'd really like to set up in the living room, where there's space enough and where the system you're so proud of can be on permanent display for awe-stricken visitors. And there's your problem.

Most living rooms are furnished with what people consider their best furniture. The style may be Danish Modern, New England Antique, Louis XV, Strained Oriental or Early Mother-in-Law, but it s the best in the house and arranged with some care.

Most computer equipment, of course, is designed in a commercial/industrial style identified as Cape Canaveral Moderne. Computer stylists strive successfully to make equipment appropriate to the bridge of a Starship, and their work is genuinely beautiful in its special way. But the typical living room is not the bridge of a Starship, and you'll have a tough time persuading the important people that your computer stuff fits in gracefully, once the cables have been tucked neatly behind the cabinets.

Interior decoration has not been uppermost in the minds of computer manufacturers straining to fill orders for what they already have. But some older, more familiar technology *is* packaged for the living room. Radios and television receivers are tidily packaged these last few decades but may be poor examples, because the user doesn't often physically work with those systems.

Pianos and organs are complex technical systems with which the user interacts rather vigorously. They're full of



Only four feet wide, the cabinet in this living room can house a large personal computer system with several peripherals, storage for books, tapes and papers, and plenty of workspace. Even the Teletype machine operates comfortably in its compartment.

Photographs by Stephen Marks

With simple rearrangement of removable shelves, the cabinet adapts to expanding or alternate systems. The widest single item encountered by the designer was this handsome aluminum cabinet housing the Digital Group computer. Not only can the computer be put in place and removed easily but the shelves may be adjusted to allow easy removal of the computer's lid for technical chores. The keyboard may be stored where it is shown but can also be set on the pull-out work counter at the left, where the operator can be seated comfortably. Other peripherals and materials are ready at hand.

knobby mechanical things, fancy linkages, strings, wires, springs and archaic delights for the tinkerer. The newest organs, loaded with more electronic components than some computers, are stuffed with integrated circuits, lights, relays, connectors and power supplies. The innards are fascinating or hideous, depending on your interest, but these systems usually manage to live in the parlor. Lots of people who don't play the piano, have no plans to learn and may not even like piano music have the devices on prominent display in their homes, because it is such a proper thing to do.

Why not computers? Manufacturers of small systems might spread their products throughout society much more rapidly with the aid of interior decorators.

Perhaps altering computer packages at the factory is unnecessary. Some furniture manufacturers may recognize a

market here and produce pieces especially for housing personal computing systems. We may soon find furniture for computer consoles at our local retail computer stores.

The keyboard for a computer is like a piano or accordion keyboard in concept and function. The paper emerging from the teletypewriter, or the data display on the face of a television tube, is like the sheet music that sits in the rack in front of the organist.

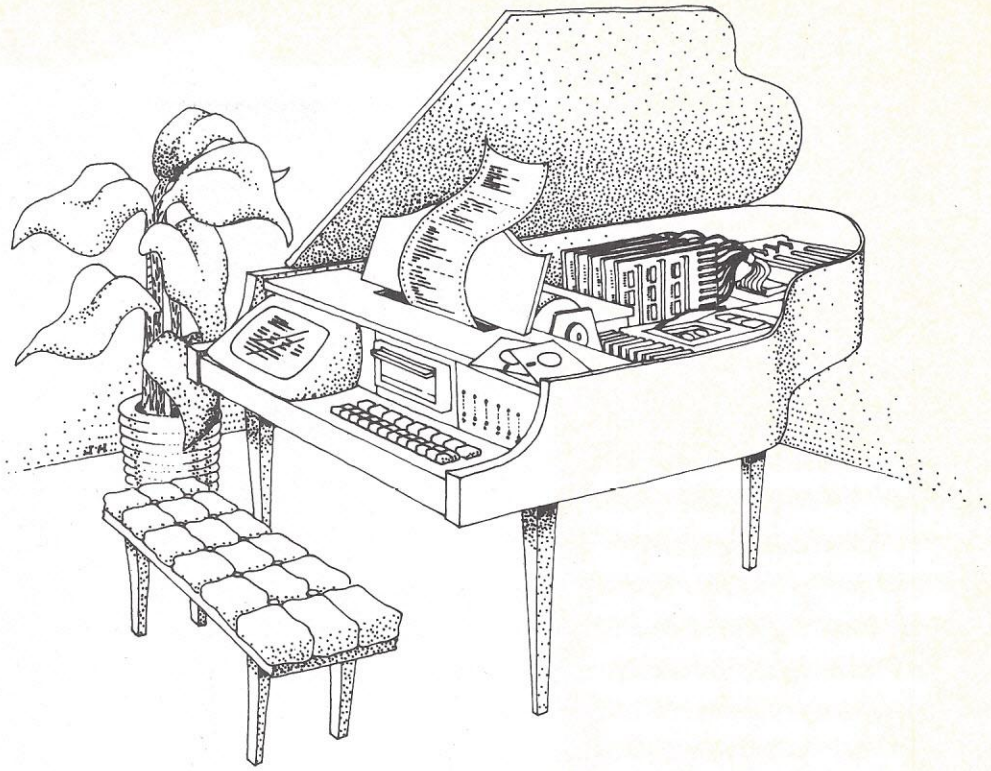
When an instrument is not processing information for eye or ear, the keys are hidden under an attractive, protective lid. The rack is folded down. Little doors are slid shut. Stops are pushed in. Flower vases are put back in place. Behold! God is in His heaven, and the parlor is as it should be.

Personal computing furniture has some requirements the piano doesn't, but they can be accommodated with the help of the industrial designer we've been maligning here. For example, you need far better access to the computer hardware inside the box than you typically need to the inside of the piano. You *must* be able to yank components out and put them back easily. You must be able to see what you're working on. All the cables must be accommodated. The electronics must be adequately ventilated and cooled (not so different from the electronic organ). The layout must be flexible, to accept occasional changes in the computer system, different display devices, keyboards, printers, plotters, peripherals of all sorts.

Some designers may want to put radio, hi-fi, and videodisc units in the same cabinet, to ease interfacing the computer with these more familiar electronics systems.

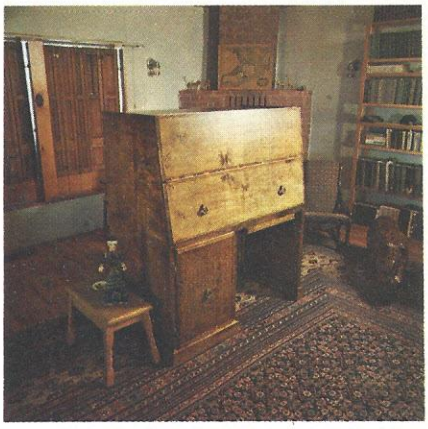
For the moment, the *appearance* of the computer system is of great concern.

Floppy disk drives and other peripherals are in easy reach on shelves below the work surface.



Artists and craftsmen have never been much consulted by the computer technologists. The computer folk have never recognized the necessity of artists in making computers welcome, not merely tolerated. The need is more apparent, now that computers are moving into our homes.

console, compact, attractive, adaptable to many styles, that can contain all of your system components. (Unless, of course, you have a large printer that must be handled in a separate cabinet.) With a nicely finished version of this basic design, perhaps you'll be allowed in the parlor.



At the left, the system's exposed, ready to go – and at the right, it's gone, out of sight in the parlor. In this case, the wood is a birch plywood, stained and lacquered, but you might choose ordinary (less expensive) plywood with a cheerful coat of paint and interesting graphics. Finish, hardware and the internal layout of uprights and shelving can be altered to suit.

You don't have to wait for this furniture to appear in the stores. PERSONAL COMPUTING has worked with a furniture designer to produce plans for building handsome furniture yourself. The do-it-yourself furniture shown in these pages can be constructed by the home craftsman with little fuss.

The first design is for a computer

To obtain detailed plans for this free-standing system cabinet, send $6.50 (New Mexico residents add 29 cents tax) to Furniture, Personal Computing, 401 Louisiana SE, Suite G, Albuquerque, N.M. 87108. For a quotation on a fully finished cabinet, designed and built by Southwestern Heritage, write to the same address.

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CIRCLE 19

LAMENT OF THE LONG-TERM REPAIRMAN
DECEMBER 1986

I remember back at the very start,
computers then weren't very smart.
Mechanical beasts, they whirred & clanked,
to get yourself an answer, had to turn
yourself a crank!

Oh yes!
Started building them computers thirty-five years ago,
and now,
they don't need me no more ※

Then vacuum tubes began to burn,
electronic wheels began to turn;
Grinding out numbers throughout the day,
the electronic age is here to stay.

Yes Sir!
Been building them computers for thirty-five years,
and now,
they don't need me no more ※

With integrated circuits the explosion came,
everbody wanted into the game.
Buy a few chips, a handful of parts,
throw them all together & you've
made a start.

Can you believe it?
Been soldering them pins for thirty-five years,
and now,
they don't need me no more ※

Then Micro Madness swept the land,
Suddenly, I was in demand.
Quite a few companies began to call
saying, "come with us, you'll have a ball".

Uh huh!
Been twiddling them bits for thirty-five years,
and now,
they don't need me no more ※

Then came the day they looked me in the eye,
said, "Jerry, my friend, your time has gone by."
Computers now take care of themselves
using magic & mirrors & software elves.
So with that they showed me the door
and said, "sorry Jerry, we don't need you no more".

Oh Lord,
After building them computers for thirty-five years,
it comes to this,
they don't need me no more ※

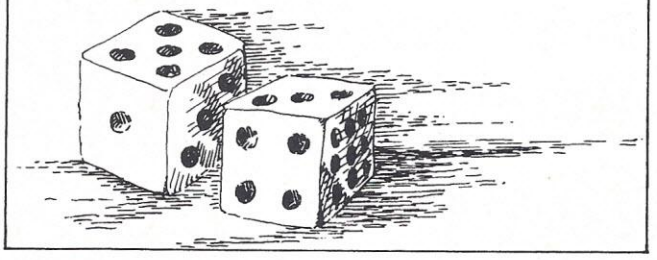
Don't need me no more: that'll be the day.
Fix themselves, hah! Ain't no way.
Pretty soon I'll hear the same sad song,
"Jerry, it's down, will repairs take long?"

Uh huh.
Been fixing them computers for thirty-five years,
and now,
They don't need me no more ※

Jim Dunion

Bearing in on Backgammon

by Nels Winkless III



"Backgammon is the perfect gambling game," insisted Harry Lawrence of Hollywood. Nobody has yet claimed that the plane in which Harry crashed during a shooting session was brought down by an overload of backgammon equipment, but the thought crossed the minds of a number of his friends who watched him break out the board, counters and dice the instant the cameras and lights were switched off and who were drawn into all-night games he won depressingly often.

Harry knew class when he saw it. He paid consulting fees to a dignified, elderly gentleman who recalled backgammon of a superior nature from the ante-World War I days on the Riviera, when he moved and played grandly among toffs like Somerset Maugham. The ancient expert instructed Harry and his associates graciously in the art and craft of backgammon while spinning out charming reminiscences.

George Glaser didn't know Harry Lawrence. Pity. They'd have done well together, but George waited too long to write the letter behind this article.

George's letter to several computer trade magazines in the spring of 1976 said he hoped to improve his backgammon game before retiring from his consulting business to the West Indies (in some decade unspecified) and asked if any computer work had been done on strategies he might employ.

A dozen responses were shot back to him, providing information on various computer projects that not only plotted strategies but pitted man against machine and machine against machine in fully elaborated backgammon games. (One system reportedly referees games between two human players and also plays one human opponent at a time at any of 10 levels of skill.) Chess had not wholly preempted the game-playing of computer systems. Backgammon was beginning to boom.

Inspired by the response, George enlarged his correspondence and began a campaign to establish a backgammon competition concurrent with the 1977 National Computer Conference in Dallas. The conference directors listened with interest to his plan unofficially, offered no money or formal support but didn't threaten to run him and his tournament out of town, either. If a backgammon tourney can be financed independently, supported with equipment at an adequate level and operated with a semblance of decorum, NCC should be approached with a proposal for official recognition of the activity.

If that seems indefinite, it's because George quickly bogged down in the correspondence and was interrupted by nagging requirements to earn a living before retirement. The project got out of hand before he could get it moving.

Recently, he presented his thoughts and collected information to PERSONAL COMPUTING. He hoped somebody here would lift the burden from him and serve his correspondents.

PERSONAL COMPUTING's small staff cannot manage such an activity, but we'll help the startup, run a small survey or two, get the interested parties together and provide magazine space for reports on league activities if somebody else wants to do the real work. We'll provide a $100 backgammon set to the winner of the first systematic competition in which at least 10 computer systems participate in games against good human players. Other backers may provide more valuable support, but *our* backgammon set will be known as the *Harry Lawrence Memorial Backgammon Award.*

George has sworn not to release the names of his correspondents without their explicit permission, so we haven't the names to publish at present. But we offer the Glaser Backgammon Bibliography for those who have not yet dug deeply into the game. You may find it useful.

Drop a note to Backgammon, c/o Personal Computing. We'll send you a copy of George's survey questionnaire and invite you to return it, filled out.

THE GLASER BACKGAMMON BIBLIOGRAPHY

Becker, Bruce, *Backgammon for Blood,* New York, E. P. Dutton & Co., 1974.

Berlinger, Hans, *A Program that Plays Backgammon,* Pennsylvania, Carnegie-Mellon University.

Cooke, Barclay & Bradshaw, Jon, *Backgammon, the Cruelest Game – The Art of Winning,* New York, Random House, 1974.

Dwek, Joe, *Backgammon for Profit,* New York, Stein & Day, 1976.

Goran, Charles, *Modern Backgammon Complete,* Chancellor Hall, 1974.

Holland, Tim, *Better Backgammon,* New York, Reiss Games, Inc., 1974.

Hopper, Millard, *Backgammon,* New York, A. S. Barnes & Co., 1941.

Jacoby, Oswald and Crawford, John R., *The Backgammon Book,* New York, The Viking Press, 1970; Bantam Books, New York, 1973 (paperback).

Keeler, Emmett B. & Gillegly, Jim, "Playing the Running Game in Backgammon," *Popular Bridge,* August 1975.

Keeler, Emmett B. & Spencer, Joel, "Optimal Doubling in Backgammon," *Operations Research,* November 1975.

Keeler, E. & Spencer, J., "Proper Raiding Points in a Generalization of Backgammon," The Rand Corp., p4078, May 1969.

Lawrence, Michael S., *Winning Backgammon,* New York, Pinnacle Books, 1973.

Levner, David, *Is Brute Force Backgammon Possible?,* Pennsylvania, Carnegie-Mellon University.

Longacre, John, *Backgammon of Today,* Philadelphia, The John C. Winston Co., 1930.

Mabardi, Georges, *Vanity Fair's Backgammon to Win,* New York, Horace Liveright, 1930.

Nicholas, Grosvenor, *Modern Backgammon,* New York, Henry Holt & Co., 1928.

Obolensky, Prince Alexis & James, Ted, *Backgammon the Action Game,* New York, MacMillan, 1969.

Richard, Walter L., *Complete Backgammon,* New York, 1940, David McKay Co., 1940.

Stern, Don, *Backgammon, the Quick Course to Winning Play,* New York, Galahad Books, 1974.

Thorne, Harold, *Backgammon in 20 Minutes,* New York, E. P. Dutton & Co., 1931.

Thorne, Harold, *Backgammon Tactics,* New York, E. P. Dutton & Co., 1931.

Tzannes, Nicolaas & Vassilios, *How Good are You at Backgammon? 75 Challenging Test Situations for You to Rate Your Ability with the Experts,* New York, Simon & Schuster, 1974.

Walling, William H. and Hiss, William J., *Backgammon Standards: How to Win at Backgammon,* New York, Simon & Schuster, 1930.

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CIRCLE 20

SPAGHETTI BASIC

PART II

Learning how to program in BASIC is as easy as learning how to make spaghetti. In this series of tutorial articles, David Bunnell explains how.

In Lesson 1 you learned how to write a BASIC language program for solving an add-on interest problem. We said that you recently purchased a motorcycle for $750. You made a down payment of $100 and financed the rest over an 18 month period at an add-on rate of 6½%.

The resulting program answered three questions:

1. What is the total amount of interest you are going to pay?
2. What is the total amount of money owed?
3. What are your monthly payments going to be?

The program was a simple one made up of LET and PRINT statements (see box). It answered our questions; however, it wasn't *glamorous* (a design engineer's term for useful). To solve another add-on interest problem would require that we enter the same program into the computer (only with new data) or, assuming that the program was still in the computer, rewrite the first three LET statements.

Suppose you wanted to figure two add-on interest problems at the same time. Would it be necessary to enter a complete program for each set of loan figures?

An efficient way of entering both loans in the same program is with the READ statement and the DATA statement used with a GOTO statement.

Let's assume that in addition to the motorcycle which you financed for $650 over 18 months at an interest rate of 6½%, you also financed a classy personal computer system for $1,800 over 30 months at an interest rate of 5¾%. The following program will solve both loan problems:

```
NEW
10 READ P, T, R
20 I=P*T*R/12
30 P1=P+I
40 M=P1/T
50 PRINT "TOTAL INTEREST IS";I
60 PRINT "TOTAL MONEY OWED IS";P1
70 PRINT "MONTHLY PAYMENTS ARE";M
80 GOTO 10
90 DATA 650, 18, .065, 1800, 30, .0575
RUN
```

Lines 10, 20, 30, 40, 50, 60 and 70 of the preceding program are executed twice. If everything goes right we get the following answer:

```
TOTAL INTEREST IS 63.375
TOTAL MONEY OWED IS 713.375
MONTHLY PAYMENTS ARE 39.63
TOTAL INTEREST IS 258.75
TOTAL MONEY OWED IS 2058.75
MONTHLY PAYMENTS ARE 68.625
```

When a group of program statements is executed more than one time it is called a *loop*. Using a READ statement and a DATA statement with a GOTO statement is one of the many ways of creating a program loop.

In Lession 1 you learned how to write a BASIC program for solving an add-on interest program. That program was as follows:

```
NEW
10 LET P=650
20 LET T=18
30 LET R=.065
40 LET I=P*T*R/12
50 LET P1=P+I
60 LET M=P1/T
70 PRINT "TOTAL INTEREST IS";I
80 PRINT "TOTAL MONEY OWED IS";P1
90 PRINT "MONTHLY PAYMENTS ARE";M
RUN
```

DATA statements

The example program has one DATA statement:

```
90 DATA 650, 18, .065, 1800, 30, .0575
```

This DATA statement is simply a list of values separated by commas. It is a means of supplying values to the variables in a READ statement(s); it is not executed.

A program can have as many DATA statements as desired Normal practice is to place them at the end of the program, where they can be quickly checked for errors. However, they can be placed anywhere in the program.

```
100 DATA 650, 18, .065, 1800, 30, .0575
```

could have been written:

```
5 DATA 650, 18
65 DATA .065, 1800
180 DATA 30, .0575
```

The line number determines the order in which DATA statements will be used. The general form of a DATA statement is:

```
line-number  DATA  value(s)
```

The values in a DATA statement must be separated by commas and must be arranged exactly as you want them as-

signed to variable(s) in the READ statement(s).

Suppose you had a program with the following READ statements:

```
10 READ A
20 READ C
30 READ F
```

and the following DATA statements:

```
70 DATA 7, 8, 9, 26
80 DATA 32, 14
90 DATA 76, 88, 99
```

The first time through this program loop, A would be assigned the value of 7, C the value 8 and F the value 9. The second time, A would be assigned the value 26, C 32 and F 14. The third time, A would be 76, C 88 and F 99. On the fourth reading the program would end.

READ Statement

The preceding example program has one READ statement:

```
10 READ P, T, R
```

This statement tells the computer that values for the variables P, T and R will be supplied by one or more DATA statements. The computer searches the program for a DATA statement(s). Once all the values in the DATA statement(s) have been read and assigned to the variables in the READ statement, the next attempt to read a value will end the program.

A program can contain more than one READ statement. 10 READ P, T, R could have been written:

```
10 READ P
20 READ T
30 READ R
```

The general form of a READ statement is:

```
line-number  READ  variable(s)
```

```
TOTAL INTEREST IS 1181.25
TOTAL MONEY OWED IS 10181.2
TOTAL PAYMENTS ARE 339.375
```

There, you have a useful program stored in the disk file of your computer. To get a list of all the program you have saved on a floppy disk simply say FILES or CATALOG, and the computer will respond with the names of all the programs you have saved.

The variables in a READ statement must be separated by commas.

When a program contains more than one READ statement or more than one variable in a READ statement, care must be used when arranging the values of the DATA statement(s). The values in a DATA statement need to be arranged in the exact order that you want them assigned to variables in the READ statement(s).

GOTO Statement

The preceding program has one GOTO statement:

```
80 GOTO 10
```

Normal program execution is sequential, i.e., the statement with the smallest line number is executed first, then the statement with the next smallest line number and so on. GOTO statements change sequential program execution.

The example, 80 GOTO 10, directs the computer to go to line 10. 15 GOTO 50 would direct the computer to go to line 50. As you can see, a GOTO statement can direct the computer to a line number that is either before or after the GOTO statement. Once a GOTO statement is executed, sequential operation resumes. The general form of a GOTO statement is:

```
line-number  GOTO  line-number
```

GOTO statements are part of a group of statements called *branch* statements. Any statement used to change sequential program execution is a branch statement.

Using READ and DATA without GOTO

If you had a program where A=10, B=20, C=30, D=40, E-50, F=60 and G=70, it would be inconvenient to enter (input) this data with LET statements:

```
10 A=10
20 B=20
30 C=30
40 D=40
50 E=50
60 F=60
70 G=70
```

A much more convenient method of entering this data would be with a READ statement and a DATA statement:

```
10 READ A, B, C, D, E, F, G
20 DATA 10, 20, 30, 40, 50, 60, 70
```

READ and DATA statements are useful for entering long lists of data.

Replacing READ and DATA with INPUT

If you worked for a finance company, you might want to store an add-on interest program in your computer to use over and over. However, in its present form, we cannot reuse our program without re-entering the DATA statements. With the use of an INPUT statement we can add a new dimension to the loan program that will solve this problem. Substituting an INPUT statement in place of READ and DATA allows you to enter principal, rate of interest and time during program execution.

The READ and DATA statements in our example program are:

```
10 READ P, T, R
90 DATA 650, 18, .065, 1800, 30, .0575
```

If you wanted to enter data during program execution, you could replace the above READ and DATA statements with the following input statement:

```
10 INPUT P, T, R
```

When an INPUT statement in a program is executed, the computer will respond with a question mark (?). You then enter a value for P, a value for T, and a value for R, separated by commas. When you press the carriage return, the computer will answer the loan problem.

With the addition of the INPUT statement you now have a program that will solve any loan problem without the necessity of re-entering the program. If you are fortunate enough to have a computer with disk storage, you can easily save the program and use it anytime you want. To do this, simply enter the following:

```
SAVE "LOANS"
```

"LOANS" is an arbitrary label for our loan program. Normally, BASIC will recognize six or fewer characters enclosed within quotes as a legitimate label. If you wanted to call the program "HOTDOGS" this would be acceptable. The only restriction is that a label cannot have any spaces. (Some computers let you omit "LOANS" and just say SAVE.)

Once the program has been saved on either a floppy or hard disk, it can be recalled to the computer's memory simply by typing LOAD "LOANS" or OLD LOANS, depending on your computer.

If you ever decide you want to remove the loan program from your file, you could do so by entering KILL "LOANS" or UNSAVE LOANS.

Editing the program

Fifty years from now when you run the "LOANS" program and the computer responds by displaying a question mark (?) chances are you won't remember what the

program labeled "LOANS" is about or what data you need to run it correctly.

Using editing techniques we can make changes and additions to our "LOANS" program that will make this identification much easier. The first step is to "load" the memory with the program labeled "LOANS," by saying LOAD "LOANS" or OLD LOANS. The computer's memory now contains the program labeled "LOANS". You can see what this program looks like by using the LIST command. Enter LIST and the computer will respond with a listing of the program:

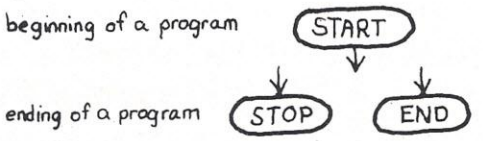
```
10 INPUT P, T, R
20 I=P*T*R/12
30 P1=P + I
40 M=P1/T
50 PRINT "TOTAL INTEREST IS"; I
60 PRINT "TOTAL MONEY OWED IS"; P1
70 PRINT "MONTHLY PAYMENTS ARE"; M
80 GOTO 10
```

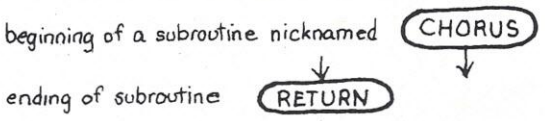
Though it is often useful to LIST a program before you edit, it is not necessary. Besides listing the entire program, many BASICs allow you to list sections or individual lines. To list line 50, enter LIST 50 and line 50 will be displayed.

As it now stands, the first statement in the LOANS program is an INPUT statement: therefore the response we get when we enter RUN is a question mark (?). This tells you nothing about the program and unless you have a good mem-

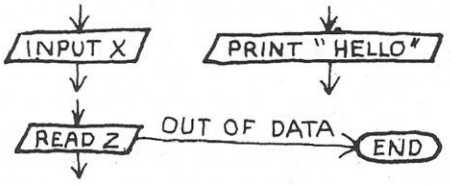
Flowchart symbols*

For beginnings and endings, use an oval:

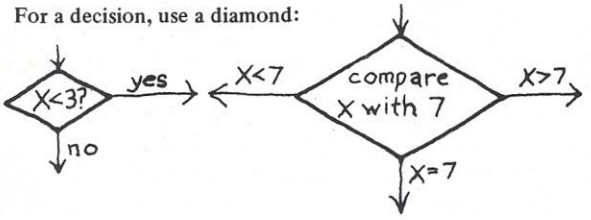




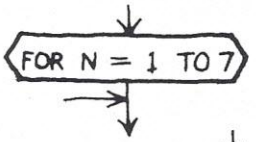
For input and output, use a slanted parallelogram:



For a decision, use a diamond:

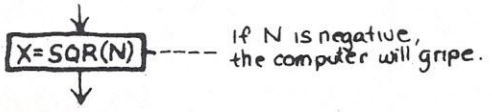


Here's how to indicate FOR:

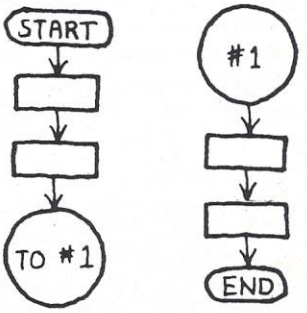


For other operations, use a rectangle:

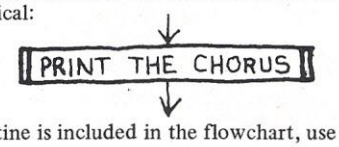
Here's how to attach a remark:



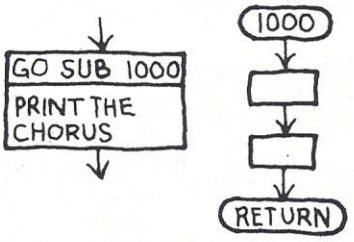
You can split a large flowchart to form smaller ones:



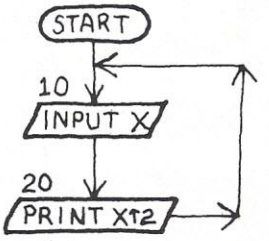
When an operation is performed by a subroutine, use stripes. If the details of the subroutine are not included in the flowchart, the stripes are vertical:



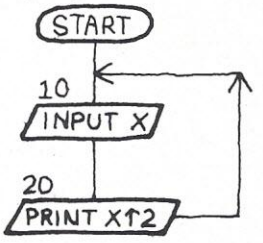
If the subroutine is included in the flowchart, use a stripe that's horizontal:



You can write the line number on the left corner of each outline:



If a flowline points in the same direction as you read English (from left to right, from top to bottom), you can omit the arrowhead:



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ory (like the computer) you probably won't always remember what it is you're supposed to enter. To make the first statement be a PRINT statement containing a brief explanation of what the program does, enter the following:

```
5 PRINT "PROGRAM FOR TOTAL INTEREST, TOTAL
MONEY OWED, MONTHLY PAYMENTS"
```

Because the PRINT statement you have just entered has a smaller line number than the INPUT statement, the computer will automatically place it at the beginning of the program. Instead of responding with a question mark when you enter RUN, the computer will now respond with an explanation of the program, followed by a question mark (?).

Now, to clarify the INPUT statement, we can add string literals to it:

```
10 INPUT "PRINCIPAL?", P, "NUMBER OF MONTHS",
T, "RATE?", R
```

This INPUT statement will replace the original INPUT statement because both statements have the same line number. When two or more statements with the same line number are entered into a program, the computer always recognizes the most recently entered statement.

Not all BASICs (including Altair BASIC) allow the use of string literals in INPUT statements. If yours doesn't, edit the program as follows:

```
10 PRINT "PRINCIPAL?"
11 INPUT P
12 PRINT "NUMBER OF MONTHS?"
13 INPUT T
14 PRINT "RATE?"
15 INPUT R
```

This is all the editing required to make our program more easily identifiable. The edited version of the LOANS program is now stored in the computer's memory. However, the unedited version is still stored in the disk file. To replace the unedited program with the edited program we simply re-save the program, by saying SAVE "LOANS" or REPLACE.

To test the effects of editing this program, clear your computer's memory and RUN the program labeled "LOANS". Instead of responding with a question mark (?), the computer now responds with the message: PROGRAM FOR TOTAL INTEREST, TOTAL MONEY OWED, MONTHLY PAYMENTS followed by: PRINCIPAL?. At this point, enter a principal of 9000 followed by a RETURN. The computer will respond with: NUMBER OF MONTHS? Enter 30 followed by a RETURN. The computer will respond with: RATE? Enter .0525 followed by a RETURN. The results should be:

```
TOTAL INTEREST IS 1181.25
TOTAL MONEY OWED IS 10181.2
TOTAL PAYMENTS ARE 339.375
```

There, you have a useful program stored in the disk file of your computer. To get a list of all the program you have saved on a floppy disk simply say FILES or CATALOG, and

Spaghetti BASIC summarized

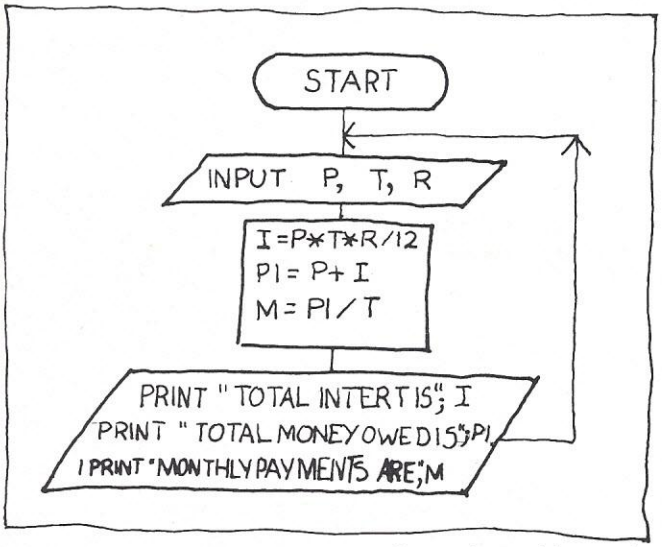
In Lesson 2 of Spaghetti BASIC, you have learned the following:

- A program loop is a group of statements that is executed more than once.
- Using a READ statement and a DATA statement with a GOTO statement is one of the many ways of creating program loops.
- A DATA statement is a list of values separated by commas. It is a means of supplying values to the variables in a READ statement.
- The values in a DATA statement must be arranged in the exact order that you want them assigned to variables in the READ statement(s).
- The general form of a READ statement is: line-number READ variable(s)
- The READ statement assigns its variable(s) to the value(s) contained in the DATA statement(s).
- The general form of a GOTO statement is: line-number GOTO line-number
- GOTO statements are used to change sequential program execution. A GOTO statement can direct the computer to a line number that is either before or after the GOTO statement.
- Any statement used to change sequential program execution is a *branch* statement.
- The general form of an INPUT statement is: line-number INPUT variable(s)
- An INPUT statement allows you to enter data during program execution.
- Any program in the computer's memory can be saved on a disk simply by entering the SAVE command followed by a label. The only restriction is that a label cannot contain a space.
- The procedure for running a program that is stored in the disk file is to first enter the NEW command and then the LOAD command followed by the name of the program enclosed in parentheses. Once the program is loaded from the disk into the computer's memory, enter RUN, followed by a RETURN.
- The procedure for deleting a program from the disk file is to enter the DELETE command followed by the name of program enclosed within parentheses and a RETURN.
- Once a program is in the computer's memory, you can list it by entering the LIST command. The LIST command can also be used to list sections of a program or individual lines.
- A program in the computer's memory can be edited by adding new statements to it or by changing original statements and re-entering them.
- To replace an unedited program in the disk file with an edited version in the computer's memory, you have to "re-save" the program. Simply enter the SAVE command followed by the name of the program enclosed within
- To get a listing of all the programs saved on a disk file, simply enter FILES followed by a RETURN. The computer will respond with the names of all the programs you have stored.
- Flow diagramming aids you in defining the problem and helps you structure the final program.

the computer will respond with the names of all the programs you have saved.

Using Flow Diagrams

In Lesson 1 we said that the most difficult part to writing a BASIC language program is defining the problem. A useful method of program outlining is the flow diagram. Below is a flow diagram of our LOANS program:

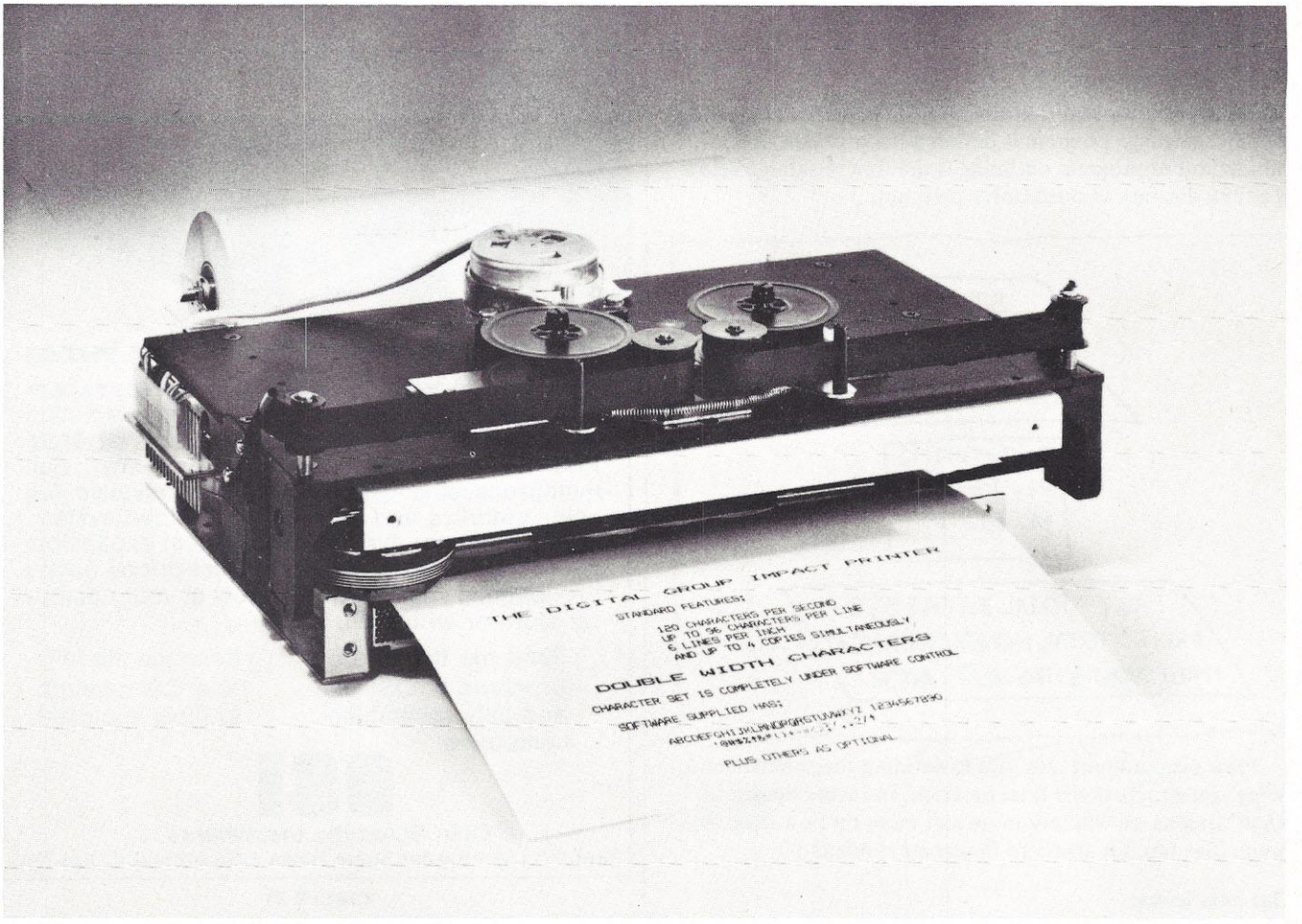


Flow diagramming aids you in defining the problem and helps you structure the final program. In future Spaghetti BASIC lessons we will rely more and more on flow diagramming. (See box for standard flowchart symbols.)

Our next lesson

You are a chef at a large hotel and one of your most frequent banquet dishes is your famous spaghetti. One problem is that these affairs vary in attendance from 25 to 5000. Thus, calculating the amount of ingredients each time is a large task. Can you write a BASIC language program on your computer that will instantly print out the amount of ingredients needed to make spaghetti for any whole number of people between 25 and 5000? Tune in next time.

"WHEN I WANT YOUR PERSONAL OPINION, I'LL GIVE IT TO YOU!"



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By Paul Allen
Vice President, Microsoft

At some point in the growth of your microcomputer system, you'll find you need a way to store your programs and data permanently. There are two places to store your data: locally, or at a remote site through a communications link.

If you store your data locally, you can choose from several different "mass" storage devices. The three main ones all use magnetic storage.

To use these storage devices with a high-level language like BASIC, "hooks" and additional statements must be added to BASIC. Storages involves more than plugging in a piece of hardware; you need software to make use of that hardware.

The essential concept in information retrieval is a *file*, a collection of characters that form a logical unit like a BASIC program, a shopping list, etc. A file has an associated *name* by which you can refer to the file in the higher-level language. Files are often broken down into *records*, which can be individual lines in a BASIC program or each individual item on a shopping list.

Audio Cassettes

The simplest and least expensive of all information retrieval systems for the microcomputer user is the *audio cassette* interface. It is usually under $150 and requires little software to interface with a high-level language like BASIC. The chart shows the additional software to BASIC occupies only 400 bytes of main memory. With this additional software, the user can save arrays (matrices) and BASIC programs on cassette.

Altair BASIC, among others, adds specific features for use with audio cassettes to let you save programs and data arrays. They are CSAVE and CLOAD. CSAVE "A" would save a BASIC program (currently in memory) on cassette as a file named "A" and CLOAD "A" retrieves program "A" from cassette. To save data on cassette, use CSAVE with the name of an array or matrix: CSAVE *A saves the array A on cassette and CLOAD *A would load in back into memory.

The OPEN statement associates a file number (1) with the file name "NUMBERS" so that subsequent statements in the program referring to file number one will use the "NUMBERS" file.

Line 7 checks whether more information remains in the file. If not, the program stops. Otherwise the INPUT statement reads a number from the file and stores it in the variable X; then the PRINT statement prints the square of X and the GOTO statement makes the program continue execution at line 7.

Floppy and Minifloppy Disks

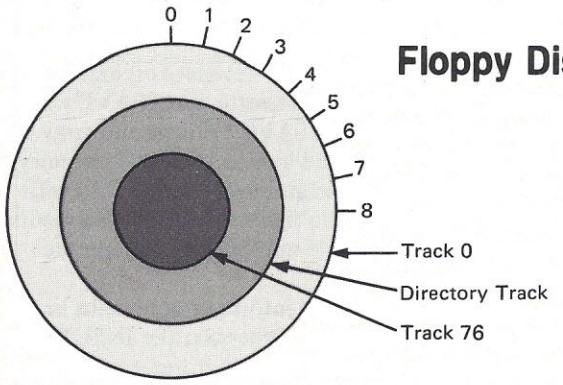
The floppy disk and its smaller brother, the Minifloppy, have advantages over digital cassettes.

Instead of being a long sequential medium, the floppy disk is organized into tracks (77 for a floppy, 35 for a Minifloppy) and several sectors per track (32 for floppy, 16 for Minifloppy). Each sector contains 137 bytes. The read/write head can position to any track within a third of a second, and a read or write operation can occur on any sector in that track in about a twelfth of a second.

Because every area of the floppy can be read or written so quickly and read or written any number of times, the

Device Requirements

	Audio Cassette	Digital Cassette	Floppy Disk	Mini Floppy Disk
Average access time	15-23 minutes	4 minutes	1/3 sec	1/2 sec
Cost of kit for drive, interface & controller	under $200	under $600	$700-$1500	$600-$900
Software Size (bytes)	400	4K	5K	5K
Data stored (after allowing room for system overhead)	64K	300K	300K	64K
Number of files	about 200	unlimited	255	127
Transfer rate (bytes/sec)	30-240	600	20K	10K
Statements added to Basic	CSAVE program or array CLOAD program or array	CSAVE CLOAD OPEN CLOSE LOAD UNLOAD PRINT INPUT IF EOFL) MERGE KILL LIVE INPUT FILES	Same as digital cassette plus: GET PUTand other random access features	Same as floppy



Floppy Disk

files on the floppy are organized in a more sophisticated manner than on an audio or digital cassette. One particular track on the disk, the *directory track*, holds the names of all the files on the disk. Sectors are allocated to a file as the information is written into the file. When a file is rewritten, any previous copy of the file is deleted. This technique of allocating and freeing up storage space as necessary is called "dynamic allocation."

Dynamic allocation of storage space has one great advantage over simpler schemes: you never have to worry where a file resides on the storage media. Instead you merely reference a file name, and the software solves the problem of where to save or retrieve the information in the file.

Another advantage of floppy disks over a digital cassette is the transfer rate. A floppy disk can read or write data at up to 20,000 bytes a second. Loading a program takes only a few seconds.

Because data anywhere on a floppy disk can be accessed within a third of a second, DISK BASIC has special features that allow information anywhere within a file to be accessed randomly. If a file consists of 100 records, the seventh or the eighth record may be read, updated and written back to the disk in under a second.

Suppose you're keeping records of orders for personal computers as a file on the floppy disk. Each individual order is a record within a file called "orders." If a customer calls up and wishes to change his order from 10 computers to 20, you can change just that and record it in the file within a second.

That is much better than having to read the whole file and rewrite it just to change the single record. Reading and rewriting the whole file takes 10 minutes or so with a large file.

All in all, the floppy disk is probably the most attractive mass storage system for the personal computer system available today. Its main drawback is cost. A single drive and controller cost anywhere between $700 and $1,500. It requires extensive software in the form of a disk operating system or high-level language. Some vendors of floppy disk devices don't offer the software, so exercise care when you choose a vendor.

But the audio cassette has some severe drawbacks. The time required to search a tape for a particular program can be long (see access item), and the rate at which data is transferred to the computer is only 30 to 240 bytes a second. You have to position the tape yourself. Modifying data already on the tape is difficult: to delete or replace data, you must erase the tape and copy the new data back.

Another problem is "overrun" of data from the cassette. Once the cassette is playing data back into the computer, the computer can't "shut off" the flow of data without losing some. In most audio cassette units an overrun condition will occur if the computer lags behind the cassette recorder by more than one or two "character times" (the time required for the cassette interface to receive and store the data). Since a character time is about 0.03 second, data will be lost if the computer has to "compute" for more than 0.03 second after receiving a character.

Digital Cassettes

A *digital cassette* system eliminates these problems. Data on a digital tape is usually formatted into records of 256 bytes with a blank unwritten space (*interrecord gap* or *IRG*) left between the records. The gap allows rewriting a particular record several times. Each file of records on the tape has a *leader*, which precedes the records of the file. The leader contains information such as file length, record size and file name. At the end of each file an *end of file (EOF)* record indicates where the file ends.

The travel rate of digital cassettes is about 600 characters a second, much faster than audio cassettes.

The software driver for digital cassettes lets you save and load BASIC program files, and input and print data files. In several systems, characters are input from a cassette file as if they had been typed in from the user terminal with an INPUT statement and output to a file with a PRINT statement. This program reads numbers from the terminal and prints the square of each number:

```
10 INPUT X
20 PRINT X↑2
30 GOTO 10
RUN
?2
  4
?6
  36
```

For a cassette input file, the program becomes:

```
5 OPEN "I" #1, "NUMBERS"
7 IF EOR (1) THEN STOP
10 INPUT #1, X
20 PRINT X↑2
30 GOTO 7
RUN
  4
  36
BREAK IN 7
```

Communication Lines

A final method of information retrieval is to store data on personal computers or on larger computers. Computers can communicate with each other over regular phone lines. At each end of the phone line is a *modem*, which translates between digital data and tones or beeps sent back and forth between the computers.

The practical limit for this kind of communication over regular phone lines is about 30 characters a second each way. If you use special (and costly) dedicated phone lines, the speed can be increased to over 50,000 characters a second.

Personal computer users could use communications lines in this fashion to send each other new programs, newsletters, etc. The future may offer public libraries of programs so you can retrieve and contribute programs merely by calling up the central computer. Adding a modem to your personal computer costs only about $150 and will cost less in the future.

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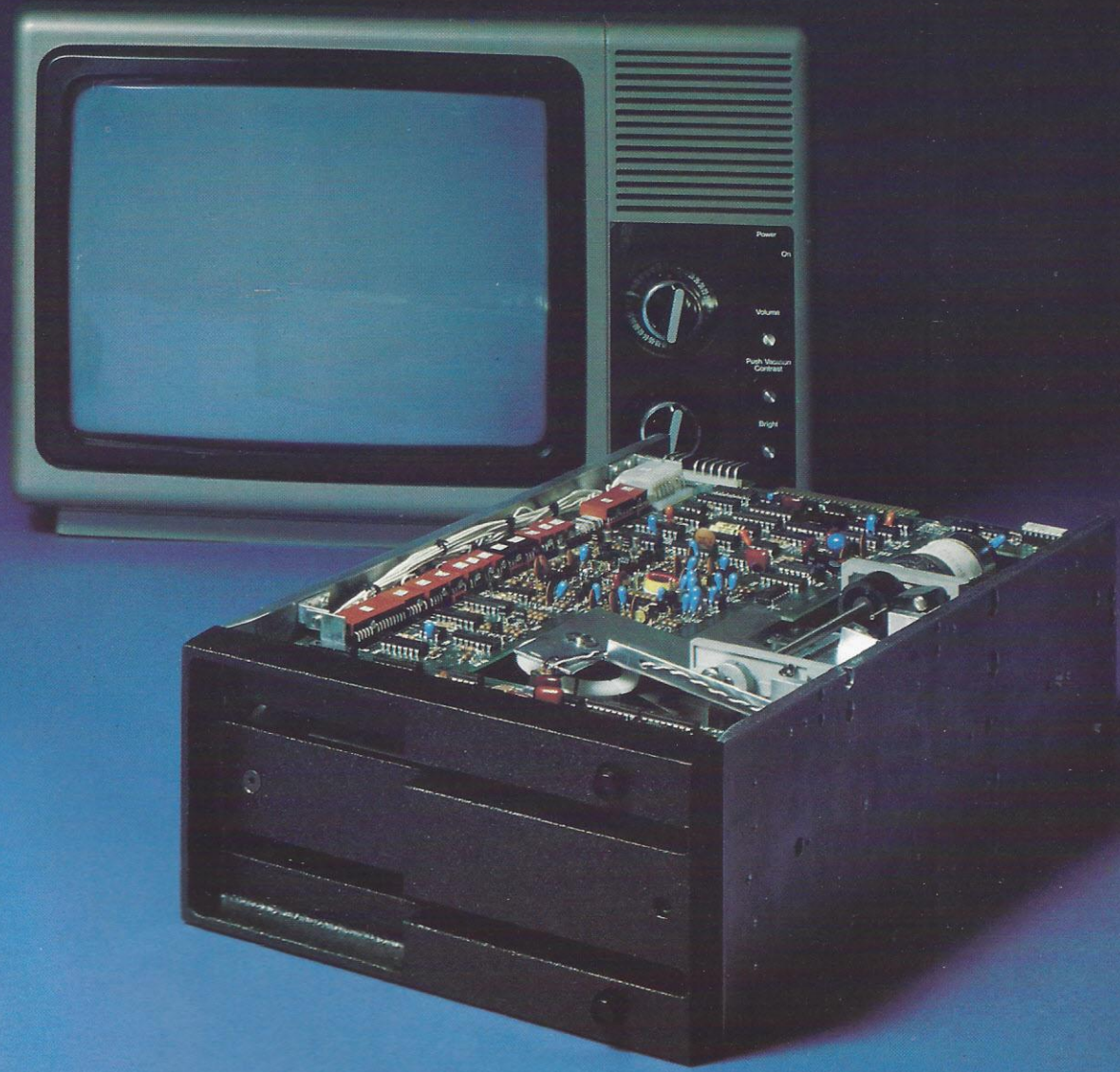

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Sol-20 is a scaled-down big computer system

Use Sol in a variety of applications.

In the home. Home uses are limited only by your imagination. Regulate heat and light to save fuel. Run a complex model railroad. Compute taxes. Play a variety of TV games, not only computer hockey and tennis, but more interesting, more complex games such as TREK-80, where your starship takes on a whole fleet of Klingons. Several sophisticated TV games come with the Sol-20. And you can even design your own.

At the office. Use it as a full-fledged business computer. Use it to compose and edit letters electronically, store and retrieve mailing lists, process orders, maintain journals and general ledgers, and produce statements and reports.

In the lab. Use Sol to reduce and analyze data statistically, control lab equipment, prepare graphics, and fit curves. Sol-20 frees your time and expands your overall capability.

In schools and universities. Use Sol-20 to teach computer programming. Use it for computer-aided instruction. Use it for notes, records and sorting.

So much is standard

Here's the computer with a microprocessor, display and input/output circuitry, memory, full alpha-numberic keyboard, big power supply, handsome cabinet, and software.

Add extras for more power

Extras include a module to help write, edit, assemble, de-bug and run your own programs. There's no better collection of add-on memories anywhere... up to 16,384 words per module. Solve additional interfacing problems with our I/O module. Get big system performance with our Helios II "floppy" disc system. Display results on our video monitor. Output on line or serial printer. Other peripherals include joysticks, paper tape readers, A/D and D/A converters, and PROM programmers.

Sol Systems

Sol computer systems are currently offered in three forms: the Sol-20, Sol-10, and Sol PC.

Sol 20 is the most complete and sophisticated of the three packages, a fully contained "personal" computer able to take on an infinite variety of tasks. Sol-20 comes with:

- 8080 microprocessor, still the most sophisticated computer-on-a-chip available and the "brains" of the Sol-20.
- 1024-character video display circuitry. View your output on any standard video monitor or specially adapted TV.
- 1024 words of static low-power read/write memory (RAM) for program storage.
- 1024 words of static low-power, preprogrammed permanent memory (ROM) takes care of important system "housekeeping" chores. ROM memory automatically readies the computer for your commands as soon as the Sol is turned on.
- a custom designed, beautifully laid-out 85-key solid-state upper and lower case keyboard with cursor keys and arithmetic keypad.
- an audio cassette interface capable of controlling two recorders at 1200 bits per second. Store and retrieve programs and large amounts of data at very low cost.
- both parallel and serial standardized interfaces with connectors on card.
- a complete rugged power supply and quiet cooling fan.
- a handsome case of walnut and metal.
- software including a preprogrammed PROM personality module and a cassette with BASIC-5 language, plus two sophisticated computer video games.
- a design compatible with all S-100 bus products.
- a back plane capable of accepting five expansion modules.

The Sol-10 Terminal Computer

Sol-10 comes in the same handsome package as the Sol-20, but because of limited memory, it is designed more specifically for "smart" terminal applications. Price of the Sol-10 includes case, power supply, and 70-key solid state keyboard. A fifteen key arithmetic pad is optional.

Later you can upgrade to a Sol-20 by adding an expansion backplane, extra power supply, fan and keypad.

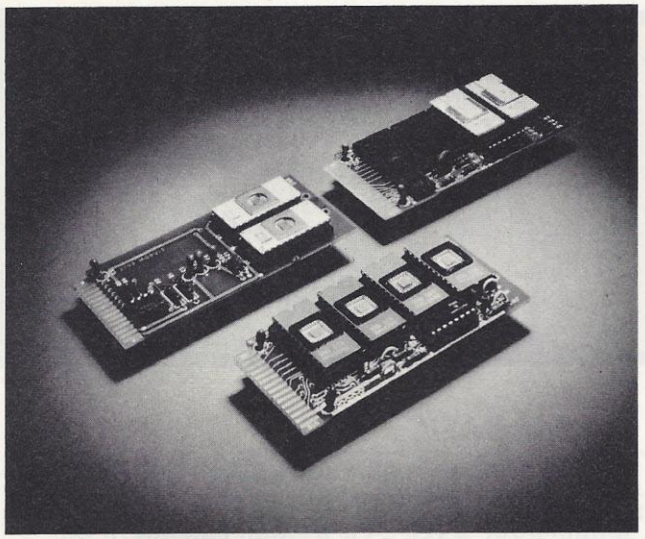
Sol-PC Single Board Terminal Computer

Here's the heart of the Sol system. The Sol-PC is a single printed circuit board with microprocessor, memory, display and interface electronics, and plug-in personality module that is fully compatible with our complete line of memory and interface modules.

The board comes in kit or fully assembled form with all of the following:

- Display: 16 lines of 64 characters per line.
- Character set: 96 printable ASCII upper and lower case characters plus 32 selectable control characters.
- Cursor: Selectable blinking. Solid video inversion. Programmable positioning standard.
- Serial interface: RS-232 and 20mA current loop, 75 to 9600 baud, asynchronous. 25 pin female "D-type" connector on card.
- Parallel interface: Eight data bits for input and output; output bus is tristate for bidirectional interfaces; levels are standard TTL. 25 pin male "D-type" connector on card.
- Keyboard interface: Seven-level ASCII encoded, TTL levels.
- Microprocessor: 8080, 8080A, or 9080A.
- On-card memory: 1024 bytes PROM (expandable to 2048 bytes); 2048 bytes low power static RAM.
- External Memory: Expandable to 65,536 bytes total ROM, PROM and RAM.
- Video signal output: 1.0 to 2.5 volts peak-to-peak. Nominal bandwidth is 7 MHz. Power required (±5%) : +5 volts at 2.5 amperes, +12 volts at 150 mA, and −12 volts at 200 mA.

A. Personality Modules



Sol Personality Modules allow you to choose three different levels of operation. Software in each module optimizes Sol for a particular application and at the same time provides a measure of general purpose capability. For custom applications and for volume OEM users personality modules are available without memory for three different types of EPROM and two types of factory-mask ROM.

SOLOS, the most popular module, optimizes the Sol for stand-alone computer applications. Choose SOLOS if you intend to use your Sol system to store and retrieve business or personal records, control electronic instruments, perform independent calculations for business, science or education, or any other application where the Sol system will be "on its own" operating independently of other computers.

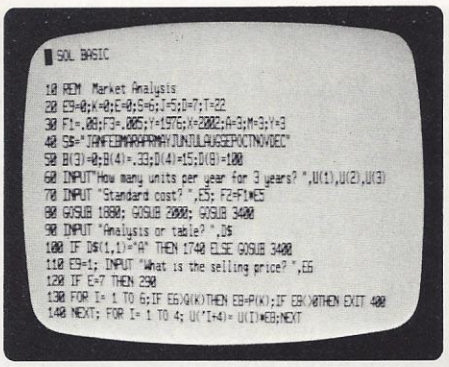
SOLOS is oriented around use of the Sol's built-in CUTS audio cassette data interface. Programs such as Sol-BASIC and ALS-8 can make extensive use of the cassette handling and screen-cursor manipulation routines contained in SOLOS. Commands included are: Dump, Enter, Execute Terminal (i.e. enter Terminal mode), Tape Load (reads CUTS format cassette tapes into memory), Tape Save (stores memory contents on CUTS tape) and Set I/O (permits dynamic switching of input and output devices under manual or program control). With SOLOS the Sol can also be used as a "smart" terminal in conjunction with other computer systems, but ordinarily the SOLED module is the better choice when the Sol system is often used as a terminal.

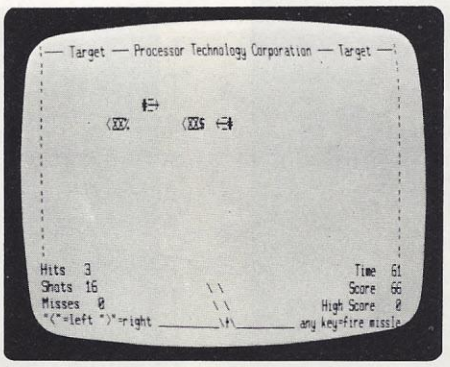
With the SOLED personality module installed the Sol becomes an advanced editing terminal system. Like SOLOS, SOLED uses the full 2048 byte capacity of its module. It contains programs and routines which allow remote direct cursor addressing and file and cassette tape editing. Data and text can be edited on or off-line and transmitted in blocks under local or remote control. Large cassette data files or text messages can also be transmitted and received automatically from remote locations.

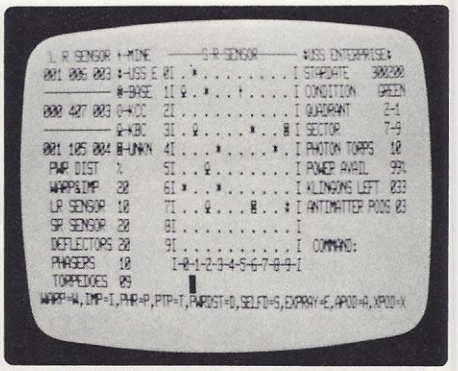
SOLED has the ability to dynamically change input and output device assignments. Stored information can be transmitted via modem, printed on one of several printers or stored on additional cassettes or flexible disks.

CONSOL is a 1024 word low cost personality module which gives minimal capability to the system. Commands include Enter, Dump, Execute, Tape Load, and Terminal. CONSOL permits operation as a low level CRT terminal and is useful for simple stand-alone applications. Full keyboard cursor control, up, down, right, left, home, clear is provided. CONSOL is not needed with SOLOS or SOLED modules because its functions are duplicated.

B. Software







Software is the sine qua non of any computer system. It's the computer power essential. No computer can be more powerful than the software that goes with it.

That's exactly why Processor Technology has devoted more effort to the development of software than other small computer makers. Maybe that's why some of our worthy competitors have taken our source listings, added a few twists and taken title. But the truth will out.

All Sol systems software is designed to make full use of the routines and programs permanently stored in all Sol personality modules. User programs such as BASIC require less memory space, because personality module routines are called up whenever needed for functions such as keyboard input, screen formatting, and cassette tape storage operations. Interface with the user is straightforward and consistent because keyboard commands and control sequences are standardized for all Sol software.

Sol BASIC

Processor Technology offers three versions of BASIC language, each suited to a different application. BASIC-5 is a small version of this versatile language designed for applications requiring just mathematical manipulation without extensive processing of text. BASIC-5 is the perfect language for an introduction to computer programming because it's easy to learn and requires a small amount of memory storage. Many hundreds of programs already written in BASIC work with Sol BASIC-5 and our 8K BASIC as well.

Processor Technology 8K BASIC is a very high speed full function language with all the virtues of BASIC-5's multiple program capability and BCD floating point math. Speed is at least double that of the already fast BASIC-5. For even greater power, we've added strings, multi-dimensional arrays and multi-line, multi-variable, user functions. Here's the language for full capability systems. For instance, in our instruction manual, take a look at the *Business analysis* program. See how you get more power while using less memory for the working program.

Advantages of Sol BASIC

Processor Technology 8K BASIC offers several unique and unusual features. Versatile print statements provide fully formatted output to multiple devices, from CRT screen to teletype to line printer. Multi-dimensional arrays permit powerful fast processing of any data that can be organized graphically or in tabular form. Several statements are provided to give complete and direct high level language control over system memory and input/output channels. Full capability string functions simplify manipulation

and processing of text and alphabetic materials so they are more straightforward and easy to use than ever before. In short, with this BASIC, no effort has been spared to bring you high level problem solving power.

Extended Disk BASIC has all the powerful features of the 8K memory-resident version and includes disk commands and big system file handling capability. Disk BASIC is perfect for such complex applications as inventory control and payables-receivables accounting.

BASIC CHART

Commands:		BASIC-5	8K BASIC	Extended Disk BASIC
ASAVE	ASCII DISK SAVE			+
CONT	Continue		+	+
CLEAR		+	+	+
GET	tape or disk	+	+	+
KILL	delete file			+
LIST		+	+	+
MEM	multiple programs	+	+	+
NULL	for printers	+	+	+
RESAVE				+
RNUM	Renumber		+	+
RUN		+	+	+
SAVE	tape or disk	+	+	+
SCR	Scratch	+	+	+
XEQ	Get + Run	+	+	+
Statements:				
CALL	call machine subroutine	+	+	+
CLEAR			+	+
CLOSE	disk file			+
DATA		+	+	+
DEF	define function		+	+
DIM(X)		+	+	+
DIM(X,Y,Z,)			+	+
ELSE	if,then,else		+	+
END		+	+	+
EXAM	memory "dump"		+	+
EXIT		+	+	+
FILL	"deposit" memory		+	+
FOR . . . NEXT		+	+	+
FREE	free space		+	+
GOSUB		+	+	+
GOTO		+	+	+
IF . . . THEN		+	+	+
INP(X),Y	from inport x		+	+
INPUT		+	+	+
INPUT," "	suppress CRLF	+	+	+
LET		+	+	+
ON	ON . . . GOSUB		+	+
OPEN	disk file			+
OUT(N),	to out port N		+	+
PAUSE			+	+
PRINT		+	+	+
PRINT USING			+	+
READ		+	+	+
READ#N	read file	+	+	+
REM		+	+	+
RESTORE		+	+	+
RESTORE	with line #		+	+
RETURN		+	+	+
REWIND	rewind file pointer			+
SET I/O	for peripherals	+	+	+
STOP		+	+	+
WAIT	for input port bit(s)		+	+
WRITE	disk			+
BASIC Functions		**BASIC-5**	**8K BASIC**	**DISK**
ABS	absolute value	+	+	+
ARG	16 bit conversion	+	+	+
ASC	ASCII value		+	+
ATN	Arctangent		+	+
CHR	Decimal value of character		+	+
COS	Cosine	+	+	+
EOF	End of file			+
EXP	e^x		+	+
INT	Integer	+	+	+
LEN	String length		+	+
LOG	Natural logarythm		+	+
LOG10	LOG base 10		+	+
RND	Random number	+	+	+
SEARCH	Search string for string		+	+
SGN	Sign of number	+	+	+
SIN	Sine	+	+	+
SQR	Square root	+	+	+
STR	Convert no. to string		+	+
TAB	PrintTAB(X)	+	+	+
TAN	Tangent	+	+	+
VAL	Convert string to no.		+	+

The ALS-8 Program Development System

Applications with very high speed data manipulations or critical timing elements demand "custom fit" programs and subroutines. High level languages written for microprocessors such as FOCAL, BASIC or FORTRAN cannot always handle these assignments. In these cases the best solution is programs written in assembly language, a language much more closely related to actual real-time computer operations. Assembly language is easy to learn and, with either of our two assemblers, quite easy to use.

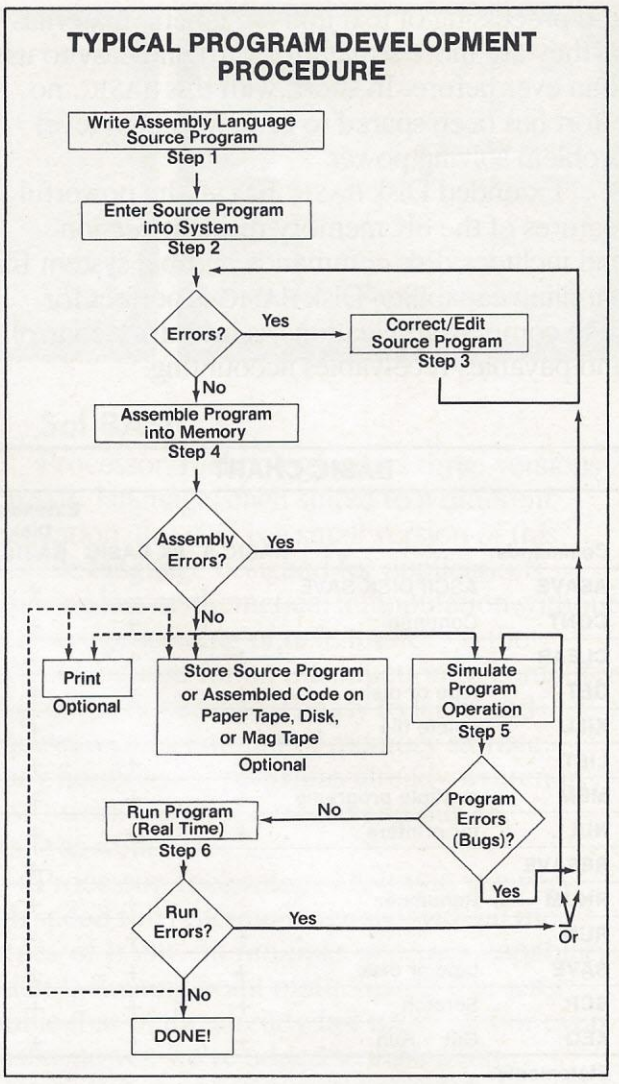
To simplify the development process as diagrammed on the right both Processor Technology assembler programs organize user programs as files.

Processor Technology's much imitated Software #1 package is a small assembler-monitor system designed for development of small to medium length programs which must be stored in system RAM memory for assembly. The ALS-8 is a more versatile and expanded development package with many additional powerful features.

With the ALS-8 up to six source programs can be stored in memory as named files and called at will to be listed, edited, assembled or simulated. Files may also be stored on tape or disk and can be assembled from any selected input device. Files can be appended, moved, re-numbered, taken apart or linked together. Using the FCHK command, crashed files can be restored.

Assembly language source programs are entered using line numbers from paper or mag tape, keyboard or disk. All editing is done by line number but with the TXT-2 Text Editing software, it becomes possible to automatically add line numbers to un-numbered text.

The Assembler includes labels, comments, expressions and constants, along with relative symbolic addressing, which gives you the ability to chain common symbols from one program to another (even if the other program was assembled at some other time). Also, various assembly error messages are provided to help you eliminate program bugs.



ALS-8, a powerful, new development procedure

ALS-8 has the unusual ability to dynamically adjust the system's I/O handling configuration. The system includes an I/O driver table accessible through use of three resident commands or the drivers themselves. I/O device driver routines may switch themselves on and off or transfer I/O control to a different device driver under program control.

Your development system might have a CRT terminal, a high speed line printer, paper tape reader/punch and a teletype. The System can print a listing to the line printer, then input from the paper tape reader and return console control to the CRT terminal or teletype, all under program control.

Up to 20 custom commands can be entered by the user and called in exactly the same way as the standard resident commands. With the

custom commands, I/O driver table, dynamic I/O switching capability and common symbol tables, you can change your system's configuration and operating modes at any time.

Resident commands are:

ASSM	CUST	ENTR	FIND	MOVE	SYME
ASSME	CUSTD	EXEC	FMOV	NFOR	SYML
ASSMI	CUSTE	FCHK	FORM	SIMU	SYSIO
ASSMX	DUMP	FILE	IODR	STAB	SWCH
AUTO	EDIT	FILES	LIST	SYMD	TEXT

Custom commands: Up to 20 specified by by user.

The ALS-8 requires 2048 bytes of random access memory (4096 is recommended) for symbol tables and system global area, addressed at D000 (hexidecimal).

The SIM-1: The SIM-1 Interpretive Simulator is a program that actually thinks it's an 8080! With the SIM-1/ALS-8 combination, simulate 8080 programs on your Sol, IMSAI, or Altair computer without actually running them in real time. All registers, flags, program counter, and stack are simulated. Try out programs with no fear of crashing your system if something goes wrong. The system doesn't lose control if a program error is encountered (e.g., an incorrect jump or call).

With SIM-1, you can set breakpoints, enable or disable register/memory content printout. I/O instructions can be run in real time, simulated from the system console, or set to predetermined values for any I/O port address.

SIM-1 is a powerful de-bugging tool for 8080 programming.

TXT-2, Text Editor

Adds the world of text editing to your system. Using TXT-2, insert, delete and move single characters, entire lines or portions of lines. Complete text files can be scanned at several user controlled rates, up to almost 2000 lines per minute when used with our VDM-1 Video Display Module.

Both ALS-8 and Software #1 packages are available on "CUTS" 1200 bps cassette or paper tape. The ALS-8 is also available preprogrammed into permanent ROM memory to provide "Instant-on" efficiency and speed.

TREK 80

Based on the NBC television series STARTREK, this machine language program uses 8K of memory and the VDM graphics capability for real time war with the Klingons. No holds barred, they're out to get you from each of the 100 quadrants. You can warp through hyperspace, fire phasers, photon torpedos or experimental rays, or if you just can't go on, self-destruct. TREK 80 resides and runs in 8K of memory and, if not used with a Sol, requires a Processor Technology VDM-1 Video Display Module.

New 8080 FOCAL (™ DEC)

FOCAL is a high level math language originally written for the PDP-8 minicomputer. Many thousands of FOCAL programs are in existence and now they can run in the Sol. Our original 8080 FOCAL has been updated to include operator precedence and all other standard FOCAL conventions. It also has a driver for VDM-1 or Sol displays and CUTS cassette program save and load. FOCAL is available only on CUTS 1200 bps Cassette and resides in 8K of memory.

Gamepac 1

Show off your Sol system with this line up of video games. Each is included on the CUTS cassette or paper tape.

TARGET — Keeps track of your hits and misses while you blast away at the numerous flying objects. Includes sound effects. You and your family will spend whole evenings at a time with this one.

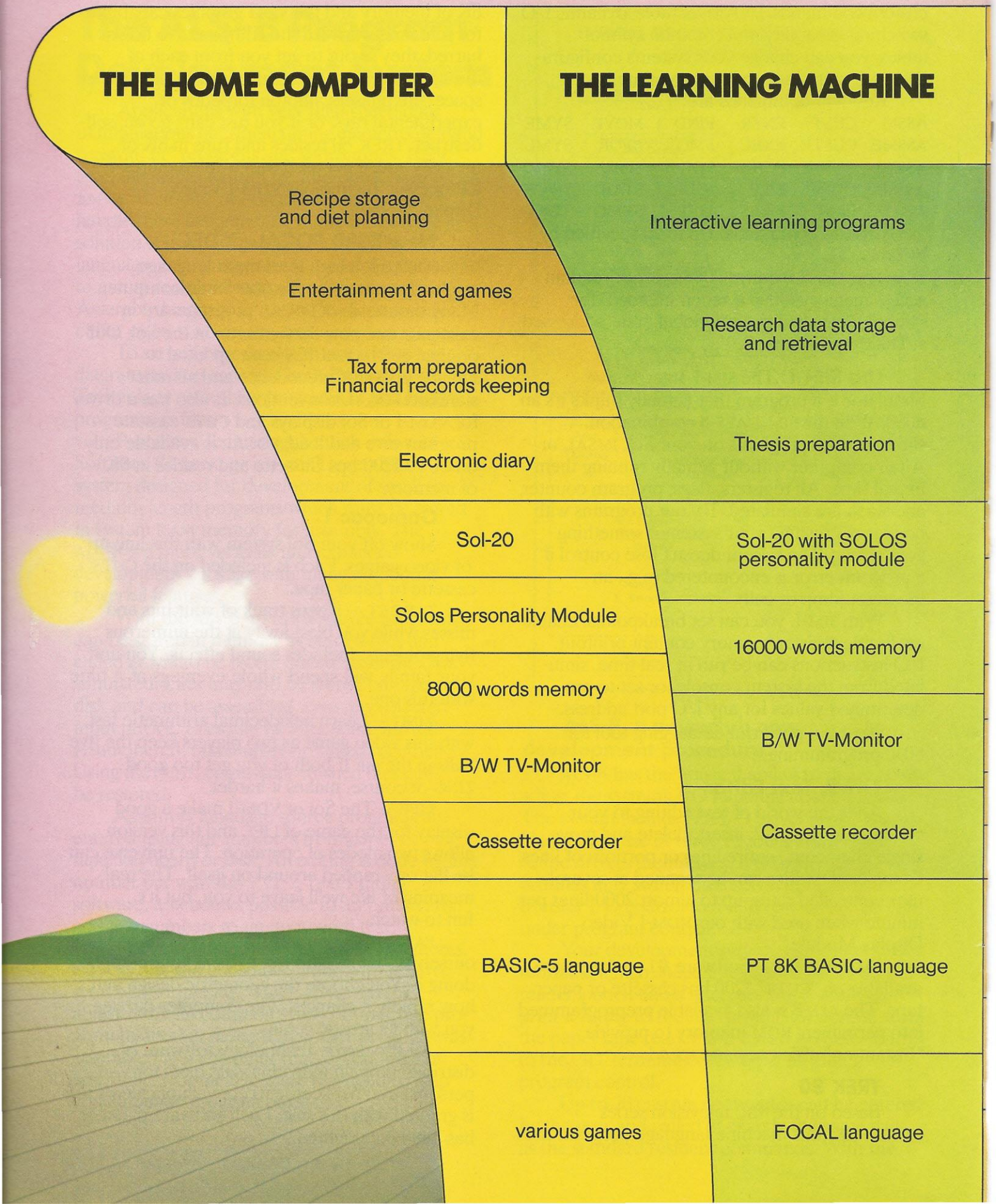
ZING — Learn hexidecimal arithmetic fast with this video game as two players keep the five balls in the air. If both of you get too good... ZING of course, makes it harder.

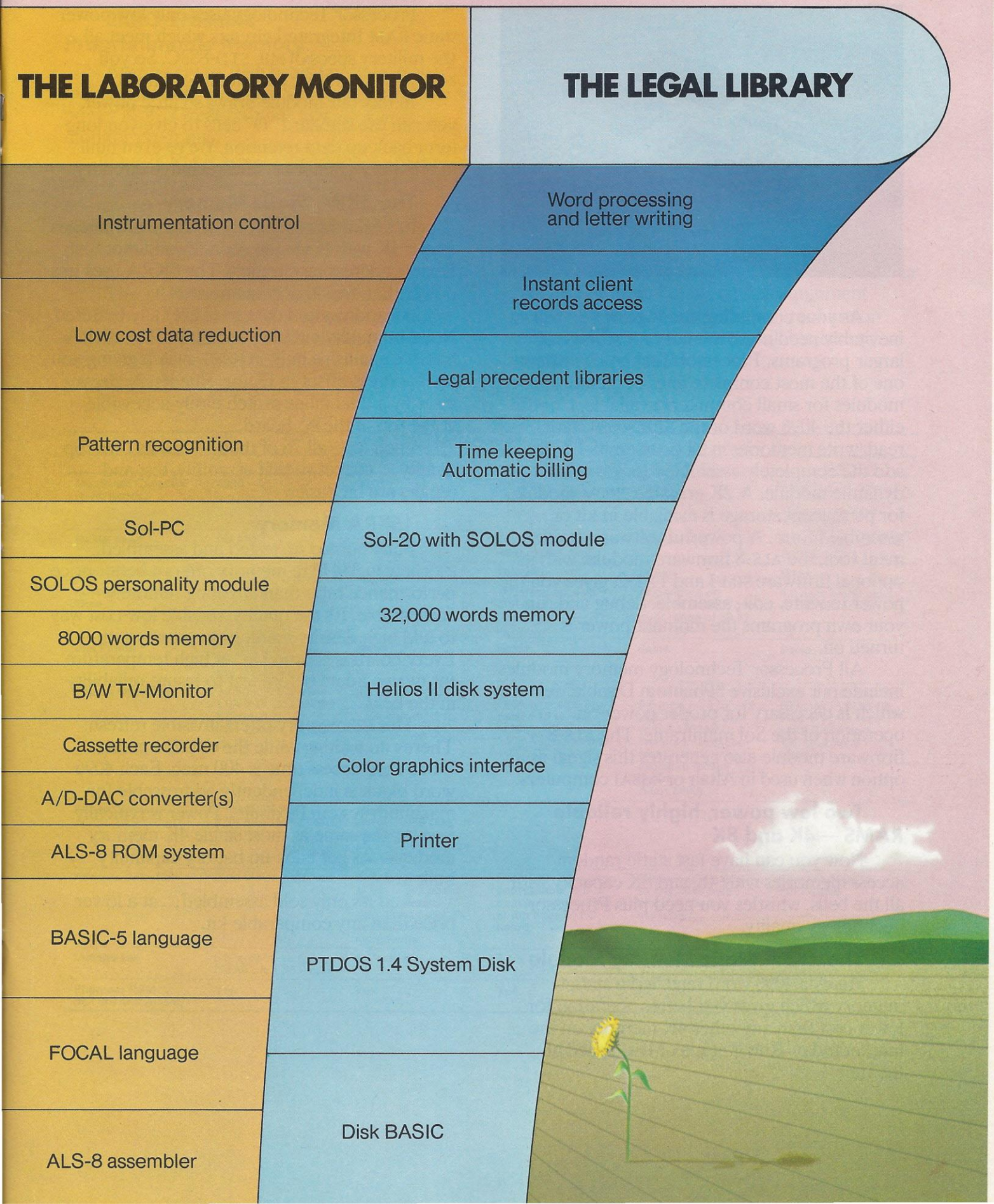
LIFE — The Sol or VDM-1 make a good display for the game of LIFE and this version allows two modes of operation. The universe can be flat or wrapped around on itself. The real meaning of life we'll leave to you, but it's fun to watch.

PATTERN — We haven't figured this one out ourselves, but it's sure fun to have your computer doing it. You choose the geometric design and how rapidly it changes. The computer dazzles you with its artistic genius.

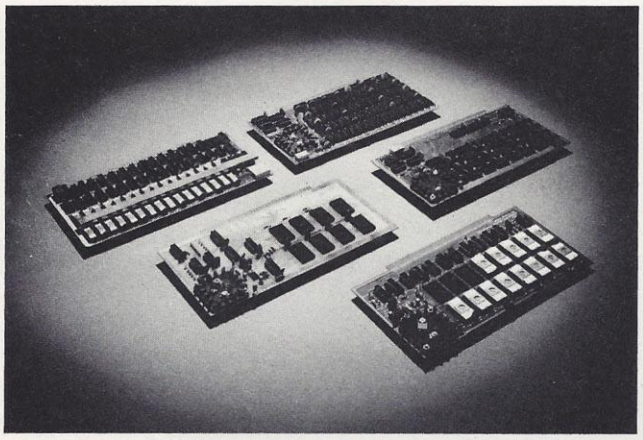
All Processor Technology software is distributed on an individual sale basis for personal use. No license to copy, duplicate or sell is granted with this sale. Each software package has been copyrighted.

Sol Solution Chart




THE LABORATORY MONITOR
THE LEGAL LIBRARY
Instrumentation control
Low cost data reduction
Pattern recognition
Sol-PC
SOLOS personality module
8000 words memory
B/W TV-Monitor
Cassette recorder
A/D-DAC converter(s)
ALS-8 ROM system
BASIC-5 language
FOCAL language
ALS-8 assembler
Word processing and letter writing
Instant client records access
Legal precedent libraries
Time keeping Automatic billing
Sol-20 with SOLOS module
32,000 words memory
Helios II disk system
Color graphics interface
Printer
PTDOS 1.4 System Disk
Disk BASIC

C. Memories



As your computing needs grow you will inevitably need more memory for storage of larger programs. Processor Technology offers one of the most complete lines of memory modules for small computers available. Choose either the 4096 word or the 8192 word static read/write memories in kit or assembled form. Or add the completely assembled 16,384 word dynamic module. A 2K erasable PROM module for permanent storage is available in kit or assembled form. A powerful software development tool, the ALS-8 firmware module, with its optional firmware SIM-1 and TXT-2, gives you the power to write, edit, assemble, debug and run your own programs the moment power is turned on.

All Processor Technology memory modules include our exclusive "Phantom Disable" feature which is necessary for proper power-on operation of the Sol mainframe. The ALS-8 firmware module also generates this signal as an option when used in Altair or IMSAI computers.

Two low power, highly reliable RAMS — 4K and 8K

Now you can have fast static random access memories with 4K and 8K capacity with all the bells, whistles you need plus Processor Technology quality.

The 4KRA Static Memory Module

Here's a 4096 word read/write static memory which gives you better operation for lower cost than any other 4K memory on the market today. Run it at max MPU speed all the time.

Processor Technology uses only low power static RAM Integrated circuits which meet all the military specs of MIL STD-883C. So you know you're getting outstanding reliability.

In fact our module draws so little power, you can use standard "D" cells to give you long term back up data retention. We've even built in a battery connector, and recharge circuitry.

The 8KRA Static Memory

PT's 8K memory gives you all the advantages of our 4K with twice the capacity and more flexible addressing circuitry. The 8KRA uses less power than two 4KRA memories.

All address and data lines are fully buffered. Noise immunity circuitry is built-in. The 8KRA has PT's exclusive built-in KSET switch giving you card address offset in 1K increments. Address is set by a dual inline switch easily accessible at the top of the PC board.

Each IC — all 76 of them — has its own top quality IC socket so that assembly, test and repairs are far easier.

16KRA Memory

Fully burned in, tested and assembled, PT's new 16,384 byte memory offers a better price performance ratio than anything remotely comparable. It's the quality, reliable low-cost way to add high density memory to your system. Every board is "burned in" at high temperature for twelve hours before test to insure reliability in the field.

This PT memory offers invisible refresh. There's no waiting while the CPU is running. Worst case access time is 400 nsec. Each 4096 word block is independently addressable for maximum system flexibility. Power is typically 5 watts, the same as most single 4K memory modules. It's got back-up battery capability built in.

And it's only sold assembled...at a lower price than any comparable kit.

2KRO Erasable Programmable Memory

Accepts up to 2048 bytes erasable programmable read-only memory. Stores data even when power is off. Great for your custom loader or monitor programs.

The 2KRO is jumper selectable to fit any one of thirty-two 2K segments within the 65K addressing range of the 8080. Additional jumpers select the appropriate number of "wait" states, determined by the access time of the EPROMs in use.

The 2KRO was designed for either the 1702A or MM5203 EPROMs. EPROMs are not included, but both are readily obtainable for reasonable prices on the industrial and surplus markets.

The ALS Firmware Module for fast software development

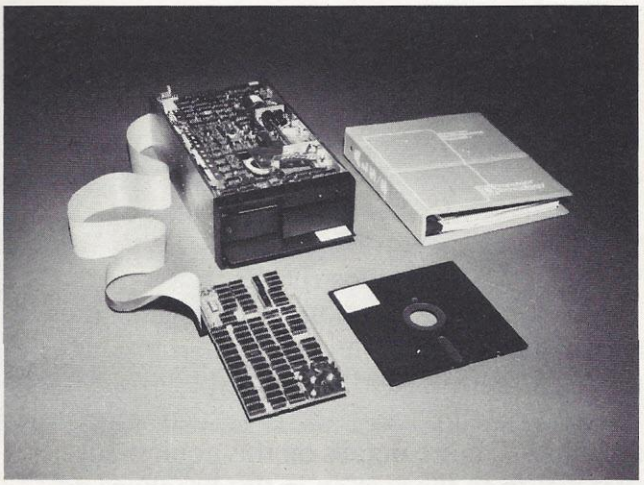
The ALS-8 is a low power "turn-on-the-switch" program developer. Quickly write, edit, assemble, de-bug and run your own programs. Here's an easy to use, easy to understand software development tool you can begin to use with only 15 minutes instruction.

Two firmware options are available, the SIM-1 Interpretive Simulator, a program that thinks its an 8080, and TXT-2 text editing firmware which adds the world of text editing to your system. For more details on this equipment please turn to the section in this brochure on software. The ALS-8 is only available factory assembled and tested.

PTC MEMORY MODULES

	4 KRA	8 KRA	16 KRA	2 KRO	ALS-8
Maximum Capacity (8-bit words)	4096	8192	16,384	2048	5120 to 8192 bytes EPROM (ROM version available March 1977)
RAMS used	91L02A	91L02A	Intel 2104 or Mostek 4096 types	1702A EPROM	5204 or 6834 EPROM (9216B ROM)
Operating Mode	Static	Static	Dynamic	Static	Static
Access and Cycle Time	520 nonoseconds worst case maximum. Typical 400 nanoseconds.	Same	400 nsec access 500 nsec cycle	Dependent on EPROM used. Works over range of 30 to 2500 nsec	1.0 μsec worst case (ROM 400 nsec)
Bus Pinout	Plug in compatible with Sol, Altair 8800 and IMSAI 8080 bus	Same	Same	Same	Same
Power: Operating	+7.5 to 10 VDC @ 1.0A max (0°C), 0.8A typical at 25°C. 0.8A typical, 1A max.	+7.5 to +10 VDC at 1.4A typical (25°C); 1.9A max (0°C to 70°C)	+7.5 to 10 VDC @ O.4A typical, 0.8A max. +15 to +18 @100mA typical, 150mA max. −15 to −18 VDC @20mA max.	+8 to +10 VDC @ 0.6 max. −15 to −19 VDC @350mA max with 8 1702As installed. (Replacement transformer available for full negative supply in Altair 8800)	+7.5 to +10 VDC @ 600 max. −14 to 19 VDC @50mA max (with SIM-1 and TXT-2 options installed)
Power: Standby	+1.6 to 2.5 VDC at 0.5A max worst case. 0.4A typical	+1.6v to 2.5 VDC typical; 0.9A max (power connector provided for battery connection)			
Address Selection	Dual in line switches	Dual inline switch at top of PC board allows manual selection of any 8K segment on 1K increments	Each 4096 byte page addressable with dual in line switches at top edge of PC board	Jumper selectable to any 2048 byte block of the 32 available.	Fixed at E000 to FFFF (hex)
Dimensions	5.3"x 10.0" (13.46 cm x 25.4 cm)	5.4"x 10.0"	5.4"x 10.0"	5.3"x 10.0"	5.3"x 10.0"
Phantom RAM (for Sol and ALS-8)	Yes	Yes	Yes	No	Yes

D. Disk Storage



Disk Storage

Every computer owner longs for all the advantages of fast random access memory. We're ready when you are to put big system disk memory power at your command. The new Helios II is more than just a floppy disk drive and controller. It's more than just scattered pieces of wire and patches of software. Helios II is a complete, integrated disk storage system which should meet every program and data storage requirement your system is likely to have. The Sol-Helios pair forms a cost effective, high performance system without equal.

Helios II gives you BIG SYSTEM PERFORMANCE

Big system performance is unique to the Helios II. Used in any application requiring manipulation of large data files, Helios II will outperform all other microprocessor based systems by a factor of at least 10 to 1.

Big system performance means all disk and memory buffer space allocation, all file management, all device interaction, comes from the system.

Big system performance means extended DISK BASIC, DISK FOCAL, and Processor Technology software support. DISK FOCAL is provided free on the system diskette and extended DISK BASIC is offered on a separate diskette for $50. Using these simple languages you can immediately write programs for any application you have in mind. The file operations include random byte or block access as well as update and rewrite in place of standard sequential files. Other application packages are under continuous development at Processor Technology. And in line with our basic software philosophy, each will reach the market at the lowest possible cost.

Helios II comes complete with dual drive, controller, system diskette with DOS, power supply, case, all necessary cables and full systems documentation. A 12K assembly language program to test and report on every aspect of your unit is included too.

Helios II loads an 8000 byte program with a look up in the system directory in 0.3 sec.... a speed which becomes truly significant when you are working on two 100K source files to create a third, adding up to a total of 200,000 bytes.

"Firm sectored" Controller raises disk storage to 386,000 bytes per diskette

The Helios controller is a genuine performance breakthrough, increasing formatted data capacity per diskette surface to over 386,000 bytes and at the same time assuring higher reliability than the older IBM format. Standard Helios II storage capacity is over 750,000 bytes. With two dual drives, capacity can be doubled to 1.5M bytes.

Asynchronous data transfers are made directly to memory at an effective rate of one million bytes per second. A sixteen byte fifo memory accumulates the data to or from the drives, freeing the computer for useful work. A standard hardware CRCC error test is performed on each transfer of data and an optional read-after-write verification mode is easily selected. The controller requires at least one S-100 bus slot and is fully compatible with Sol, Altair or IMSAI systems.

No need to buy special, expensive diskettes — the controller will pre-format any standard 32 hole "floppy" diskette.

Software

PTDOS 1.4.0 is a proven disk operating system with total file and memory management. Features include:

Complete management of static, dynamic user buffers.

Device files for generality of input/output operations.

System calls for complete file operations from external programs.

Three level, triple option error handling/ trapping.

Random/Indexed Files for direct positioning to any word of a file, anywhere on the disk(s).

Command Line Interpreter accepts and executes a string of commands from you or a file.

System utility call performs a random search to the utility operation of your choice.

Helios II can be configured and reconfigured for any size buffer area. Over 40 files can be open at one time. System calls provide standardized access for all file operations from external programs and routines.

The Command Interpreter accepts input from the current command input file to provide direct file operations from the keyboard or another file. Support program calls are identical to commands, but executed outside of the system area (e.g. in low memory).

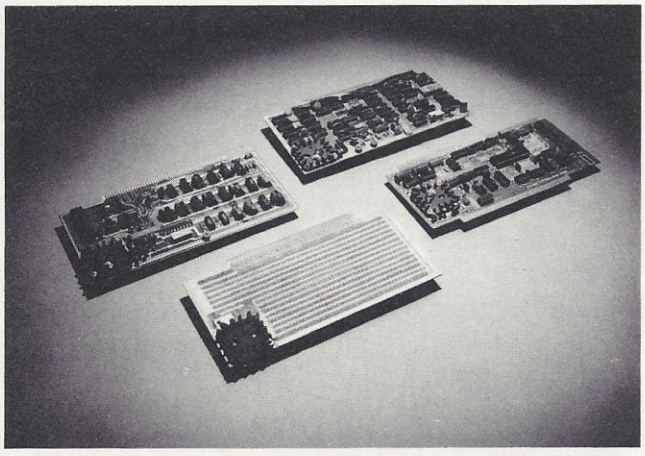
Want more information

A full product description of Helios II is available for $1. We are also making the PTDOS 1.4.0 portion of the Helios II System Manual available for $20. (which we credit toward your purchase of the system). But, if you are already familiar with the consistent quality, features and support given to all Processor Technology products, order your Sol-Helios system today. You'll have Big System Performance working for you that much sooner.

New extended DISK BASIC

Further increasing the value of your Helios II is our extended DISK BASIC. This powerful language offers advanced string and math functions plus direct commands (SAVE, RESAVE, ASAVE, KILL and XEQ) and program statements. DISK BASIC is the only available small computer BASIC with powerful disk file handling commands, statements and functions. These features make complex application programs for inventory control, data reduction and general accounting run ten times more efficiently on the Helios system.

E. Interfaces



When we talk about making the complete small computer, we mean interfaces, too. Nothing is left out. There's a video display module designed to work with computing equipment you may already have or auxiliary equipment you may need. There's the Computer Users Tape System so you can add additional audio cassette tapes for expanded program and data storage/interchange. There's a wire wrap extender board for anyone who does prototyping. If you're troubleshooting, you can see what you're fixing with Processor Technology's Extender Board. You can handle any additional input/output needs of your system with our 3 P+S Input Output Module.

In sum, Processor Technology has built every basic element you need into Sol for integral operation. And we have generated the extra equipment for use with peripheral devices or other existing computer you may have. Processor Technology is dedicated to helping you get optimum computer performance.

VDM-1 Video Display Module

We call it the communicator. It provides almost Sol-like performance for Altair and IMSAI computers. It's a high speed module which has 1024 bytes of random access memory, scrolling and multiple programmable cursor circuitry. Sixteen 64-character lines are generated in a large easy to read upper and lower case font. Data handled by the read/write on-card memory is displayed instantaneously with no interference to the processor. Top display scroll speed is 2000 lines per minute!

VDM-1 lets you display white on black or black on white. VDM-1 offers EIA video output. Terminal mode software comes with the module at no extra cost so you can use it with your existing programs. Most Processor Technology software packages already include versions of these display driver routines, so no time comsuming software patching is necessary. The VDM-1 can be used in Sol systems to add a second display output for expanded special applications.

CUTS: The computer users tape system

Here's the low cost high speed audio cassette interface for computer program and data storage interchange.

Operate at 300 bits per second or 1200 bits per second in the new Processor Technology CUTS format, upward compatible with the "Byte/Kansas City" standard. (see Popular Electronics, p. 86, March 1976)

Using CUTS you can load programs ten times faster than with a teletype paper tape reader. You can load Processor Technology BASIC in 58 seconds. There are no critical adjustments. Just about any ordinary cassette recorder will do. CUTS has AGC in both read and write modes. So you won't lose bits at 1200 or 300 baud.

Software on CUTS cassettes costs less than equivalent paper tape.

The following software for the CUTS module is available for $11, all on one cassette.

A. CUTER™ — Computer Users Tape Entry and Retrieval monitor program.
B. BASIC-5 with CUTER compatible commands implemented.
C. Lunar Lander written in BASIC-5.

Many more programs are under development. You can reasonably expect a new one every few weeks.

Wire Wrap and Extender Boards

Wire wrap boards are designed for prototyping. Create custom interfaces or whatever your fancy dictates.

WWB has a "universal" seven-row pattern of pads on .3" centers, so standard 14, 16, 24 and 40 pin DIP IC sockets can be plugged right in. Power and ground are dedicated to pins 16 and 8 respectively (for 16 pin DIPs). Converts to other IC sizes easily. Use up to 62 sixteen-pin DIP ICs; six extra wirewrap socket positions have been set aside for wire wrap connections to any S-100 bus computer (Altair or IMSAI).

Use the Extender Board to help you troubleshoot any S-100 bus compatible module. Plug in a glitchy module 5" above the mother board for easy scope, VTVM or logic probe. Sol-20 systems already have a built-in extender connector on the back plane assembly.

3P+S Input Output Module

Processor Technology's 3P+S input/output module offers a low cost way to handle virtually all the I/O needs of any S-100 bus compatible computer system.

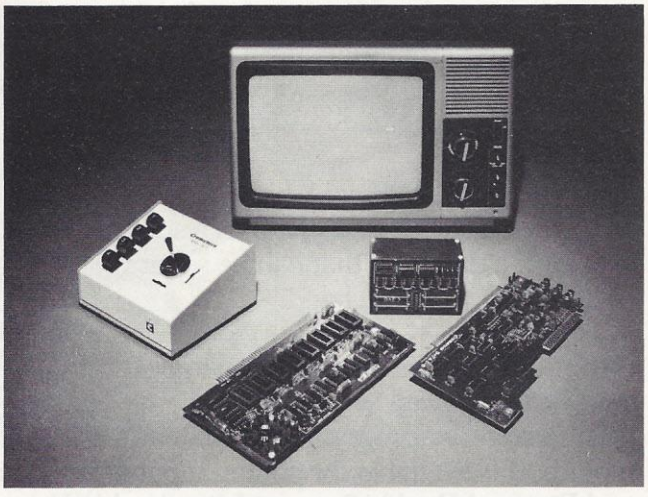
The 3P+S has two 8-bit parallel I/O ports, with full handshaking logic, plus a serial I/O port with a data rate that can be set anywhere between 35 and 9600 baud.

One parallel output port can be used to set up control conditions for both parallel and serial ports, as well as for setting the serial I/O baud rate under program control. One parallel input port is available for polling Input Data flags and External Device flags, and for checking the serial I/O error flags. You can implement full handshaking with both input and output peripherals.

Interfacing to the Sol System, Altair 8800, or IMSAI 8080 vectored interrupt bus is provided by a jumper selectable option which allows any of the UART (Universal Asynchronous Receiver Transmitter) error flags or handshaking signals to generate interrupts. (A Vectored Interrupt Module is also required for this mode of operation.)

Addressing of the module is selectable to any of 64 address segments within the range of 256 I/O addresses.

F. Peripherals



Peripherals

Processor Technology has selected a number of quality peripheral devices from other manufacturers to help you put complete systems together for many different applications. All these devices are only available factory assembled and tested.

TV-Monitor

Here's an 11" diagonal completely solid state black and white television specially modified for use with the Sol or VDM-1 units. A switch allows use as either a standard UHF/VHF television or as a video monitor. These units provide extremely crisp and stable displays and are fully grounded for safety. Manufactured by Panasonic.

High Speed Paper Tape Reader

All programs produced on paper tape for the 8080 may be loaded into Sol at up to 1000 characters/second with this handy low cost paper tape reader. The OP-80 is completely solid state and has no moving parts. The unit comes with a cable for plugging directly into the Sol Parallel Data Interface connector. Made by Oliver Audio Electronics.

PROM Programmer

The Bytesaver™ PROM programmer gives you two powerful features:

1) fast easy programming of 2708 Erasable Programmable Read-Only Memories (EPROMs).

2) Sol-bus compatible non-volatile storage of up to 8192 bytes of program.

The Bytesaver can be used to permanently store programs for use on custom application Sol personality modules or for expanded permanent storage.

Use the Bytesaver in any application where your special programs need to be permanently stored yet instantly accessed by the computer. Complete driving software included at no extra cost. Manufactured by Cromenco.

Multi-channel Analog Interface

The D+7AI/O™ module is the low cost efficient way to interface the Sol System's digital computer with the analog world. Use this module when joysticks, instruments and amplifiers, voltage and temperature sensors or any other analog device needs to be controlled or monitored by the Sol Computer.

Provided are:

- 7 multiplexed analog input channels for Analog to Digital conversion with 8 bit resolution and 5.5 microsecond conversion time.
- 7 Digital to Analog output channels with 8 bit resolution.
- 8 bit parallel interface post for digital control applications.
- +2.56 to −2.54 VDC input and output signal range (20mV monotonic increments).

The D+7AI/O is software compatible with the ALS-8 development system and PT8K BASIC language. Manufactured by Cromenco.

JS-1 Joystick

The Joystick is the fastest data entry method for interactive prompted programs and games. The JS-1 has both two axis analog outputs and four on-off switches. Requires D+7AI/O module. Manufactured by Cromenco.

SOL SYSTEM PRICE LIST (Prices are net, effective March 1, 1977)

1. Sol Terminal Computers	Kit Price	Assembled and Tested
A. Sol-PC Single Board Terminal Computer™	$ 575*	$ 745
B. Sol 10 Terminal Computer (includes case, power supply and 70 key solid state keyboard)	$ 895*	$1295
C. Sol-20 Terminal Computer (includes all features of Sol-10 plus a larger power supply, fan, 85 key solid state keyboard and five slot expansion backplane)	$1095*	$1495
D. SOLOS or SOLED Personality Modules (if ordered separately)	$ 150	$ 175
*Sol prices include either SOLOS or SOLED personality module. Please note on your order which module is desired. Kits (only) are available with CONSOL personality module for $100 less than above prices.		
2. Mass Storage Systems		
Helios II Disk System™ (Includes dual Persci 270 floppy disk drive, cabinet, fan, S-100 bus compatible controller, power supply, system diskette with complete PTDOS software)	$1895	$2295
3. Memory Modules		
A. ALS-8/ROM Resident Assembly Language Operating System (ROMs only) Requires GPM Module	$ 159	$ 159
B. SIM-1 and TXT-2 Add-on (Requires GPM and ALS-8/ROM)	$ 60	$ 60
C. GPM General Purpose Memory Module (includes 1024 bytes RAM and 1024 bytes PROM or ROM)	$ 129	$ 169
D. GPM-Sol (GPM Module without RAM and ROM, Sol Systems already include RAM and ROM at same addresses)	$ 89	$ 119
E. 2KRO Erasable PROM Module	$ 65	$ 89
F. 4KRA 4096-word Low Power Static RAM	$ 159	$ 195
G. 8KRA 8192-word Low Power Static RAM	$ 295	$ 375
H. 16KRA 16384-word Dynamic RAM	—	$ 529
4. Interface Modules		
3P+S Parallel, Series I/O Module	$ 149	$ 199
CUTS Computer Users Tape System cassette interface	$ 87	$ 119
VDM-1 Video Display Module	$ 199	$ 295
5. Peripheral Modules		
A. Bytesaver PROM Programmer Module	—	$ 245
B. D7+A I/O Analog-Digital interface	—	$ 245
C. EXB Extender Board	$ 35	$ 45
D. JS-1 Joystick console	—	$ 95
E. OP-80 Paper Tape Reader	—	$ 100
F. PT-872 TV-Video Monitor by Panasonic	—	$ 199
G. WWB Wirewrap Prototyping Module	$ 40	—

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6. Sol Systems		
Complete systems are available from Processor Technology to fulfill the application requirements outlined on the Sol Solution Chart in our catalog. These systems include all necessary connecting cables and manuals.		
A. Sol System I Sol-20/SOLOS 8KRA memory PT-872 TV-monitor RQ-413 Cassette Recorder	**$1649**	**$2129**
B. Sol System II Sol-20/SOLOS 16KRA memory PT-872 TV-monitor RQ-413 Cassette Recorder	**$1883**	**$2283**
C. Sol System III Sol-20/SOLOS Helios II Disk system 2-16KRA memories PT-872 TV-monitor DISK BASIC Diskette	**$4237**	**$5037**
7. Sol Upgrade kits		
A. UGKPC-20 Sol cabinet, 85 key keyboard, fan, power supply and expansion backplane. Upgrades Sol-PC kit to Sol-20	**$ 565**	—
B. UGK10-20 15 key arithmetic pad, fan, power supply and backplane expansion. Upgrades Sol-10 kit to Sol-20	**$ 250**	—
C. UGKPC-10 Sol cabinet, 70 key keyboard and power supply. Upgrades Sol-PC kit to Sol-10	**$ 355**	—

8. Software (including manual)	CUTS cassette	Paper tape	Minimum memory required
A. Basic 5, Software #2	**$14.50**	**$19.50**	**8K**
B. 8K BASIC	**$29.00**	**$37.00**	**12K**
C. New 8080 FOCAL	**$14.50**	**NA**	**8K**
D. TREK 80 video game	**$ 9.50**	**$14.50**	**8K**
E. GAMEPAC 1 video games	**$ 9.50**	**$14.50**	**4K**
F. MATHPACK video calculator	**$14.50**	**$19.50**	**4K**
G. ASSEMBLERS: Software #1 Resident Assembler Package	**$14.50**	**$19.50**	**6K**
H. ALS-8 Resident Assembler, Simulator and text editor	**$35.00**	**$45.00**	**12K**

Attention

Sol system owners be sure to note Sol system on your order. These special versions use less code and provide easier loading along with more convenient operation. SOLOS, SOLED, and CONSOL all have provision for the special versions.

Note: All prices are f.o.b. Emeryville, California. Delivery normally stock to three weeks after receipt of order. Prices and specifications subject to change without notice.

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Byte Shop East
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Byte Shop West
12654 N. 28th Dr.
Phoenix, AZ 85029

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The Byte Shop
1514 University Ave.
Berkeley, CA 94703

The Byte Shop
2626 Union Ave.
Campbell, CA 95124

Byte Shop Computer Store
6041 Greenback Lane
Citrus Heights, CA 95610

The Byte Shop
16508 Hawthorne Blvd.
Lawndale, CA 90260

The Byte Shop
1063 El Camino Real
Mountain View, CA 94040

The Computer Mart
624 West Katella #10
Orange, CA 92667

The Byte Shop
2227 El Camino Real
Palo Alto, CA 94306

The Computer Store
of San Francisco
1093 Mission Street
San Francisco, CA 94103

The Byte Shop
155 Blossom Hill Rd.
San Jose, CA 95123

The Byte Shop
509 Francisco Blvd.
San Rafael, CA 94901

The Byte Shop
3400 El Camino Real
Santa Clara, CA 95051

The Byte Shop
2889 North Main St.
Walnut Creek, CA 94596

Recreational
Computer Centers
1324 South Mary Ave.
Sunnyvale, CA 94087

FLORIDA

Microcomputer
Systems Inc.
144 So. Dale Mabry Hy.
Tampa, FL 33609

GEORGIA

Atlanta Computer Mart
5091-B Buford Hwy.
Atlanta, GA 30340

ILLINOIS

The Numbers Racket
518 East Green Street
Champaign, IL 61820

itty bitty machine co.
1316 Chicago Ave.
Evanston, IL 60201

itty bitty machine co.
42 West Roosevelt
Lombard, IL 60148

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The Data Domain
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Bloomington, IN 47401

The Data Domain
219 West Columbia
West Lafayette, IN 47905

The Data Domain
7027 N. Michigan Road
Indianapolis, IN 46268

KENTUCKY

The Data Domain
3028 Hunsinger Lane
Louisville, KY 40220

MICHIGAN

The Computer Store
of Ann Arbor
310 East Washington
Ann Arbor, MI 48104

General Computer Store
2011 Livernois
Troy, MI 48084

NEW JERSEY

The Computer Mart
of New Jersey
501 Route 27
Iselin, NJ 08830

Hoboken Computer Works
No. 20 Hudson Place
Hoboken, NJ 07030

NEW YORK

Audio Design Electronics
487 Broadway, Ste. 512
New York, NY 10013

The Computer Corner
200 Hamilton Ave.
White Plains, NY 10601

The Computer Mart
of Long Island
2072 Front Street
East Meadow, L.I. NY 11554

The Computer Mart
of New York
314 Fifth Ave.
New York, NY 10001

Synchro Sound Enterprises
193-25 Jamaica Ave.
Hollis, NY 11423

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The Real Oregon
Computer Co.
205 West 10th Ave.
Eugene, OR 97401

Byte Shop Computer Store
2033 S.W. 4th Ave.
Portland, OR 97201

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High Technology
1020 West Wilshire Blvd.
Oklahoma City, OK 73116

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Computer Power, Inc.
M24 Airport Mall
1800 Post Road
Warwick, RI 02886

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The Micro Store
634 So. Central Expressway
Richardson, TX 75080

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The Retail Computer Store
410 N.E. 72nd
Seattle, WA 98115

WASHINGTON, D.C. Area

Media Reactions Inc.
11303 South Shore Dr.
Reston, VA 22090

WISCONSIN

The Milwaukee
Computer Store
6916 W. North Ave.
Milwaukee, WI 53213

CANADA

The Computer Place
186 Queen St. West
Toronto, Ontario M5V 1Z1

Trintronics
160 Elgin St.
Place Bell Canada
Ottawa, Ontario K2P 2C4

First Canadian
Computer Store Ltd.
44 Eglinton Ave. West
Toronto, Ontario M4R 1A1

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4509-11 Rupert St.
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Maybe you don't need these books...

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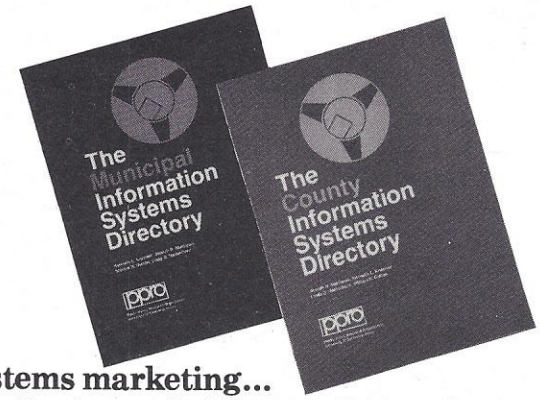
A.M. Colella is with the U.S. Department of Transportation; **M.J. O'Sullivan** and **D.J. Carlino** are with Northeastern University. 320pp.



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Walter J. Weller, the author, is a mini-computer software consultant based in Chicago, working in industrial, medical, and educational applications of small computers. 304pp.

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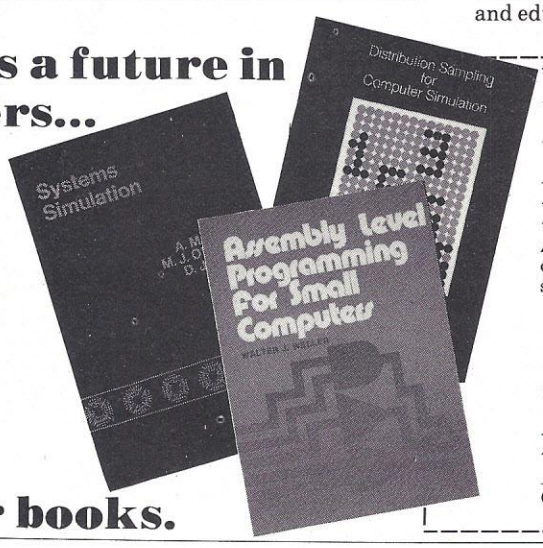

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CIRCLE 35

a look at computer retailing

by Nels Winkless III

When you step into a neighborhood computer store, jingling coins in your pocket and asking thoughtful questions about the merchandise, you are exercising real power as a customer to influence the future course of personal computing. Your influence in the next couple of years may be far greater than you realize, because the very idea of computer sales at retail is brand new and nobody – not the manufacturer, store operator, publisher nor customer – has a reliable basis for judging what the future holds. Before traditions are set and innovation becomes difficult, the individual customer has a remarkably attentive listener in the computer storekeeper who is eager to learn how his big risks can produce rewards for him. The storekeeper carries insights and money back to manufacturers who are also in a temporary learning mode. Unless human nature has changed recently, interest in learning will vanish just as soon as everybody thinks he knows something. As a computer consumer, you have a lucky chance to get in your licks while confusion reigns. You'll find it helpful to know a little about the retailing field as it now operates.

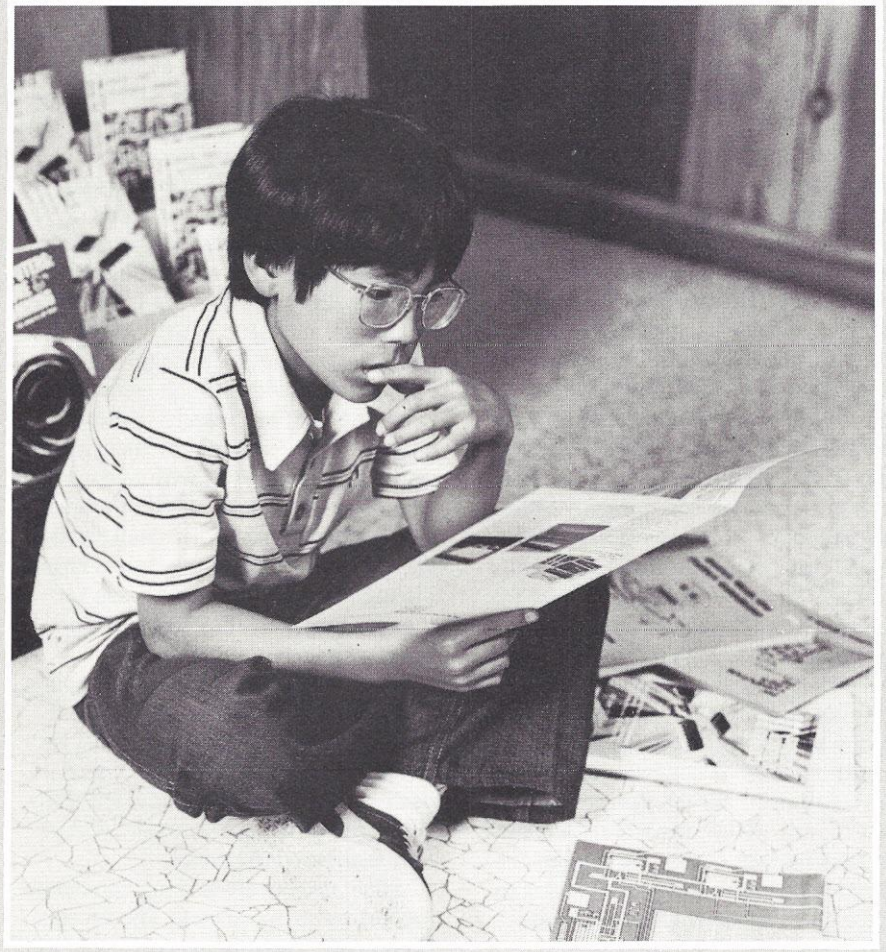


Photo courtesy Byte Inc.

This is a characteristic scene in the retail stores, where browsers sift through the reading matter for hours on end, soaking up information. Our next generation of computer experts may be educated chiefly while sitting on computer shop floors.

The Stores Have Arrived

Until Dick and Lois Heiser opened a retail computer store in Santa Monica, Calif. in July 1975 (not in October, as PERSONAL COMPUTING inadvertently said in its last issue) the world had struggled through its entire

Photo courtesy Amer. Used Computer Corp.

Three thousands hobbyists went to the grand opening of the world's largest computer store. For prizes, Boston's Computer Warehouse Store gave away used equipment originally valued at $100,000. Manufacturers set up booths in the store and dazzled the hobbyists with their demonstrations.

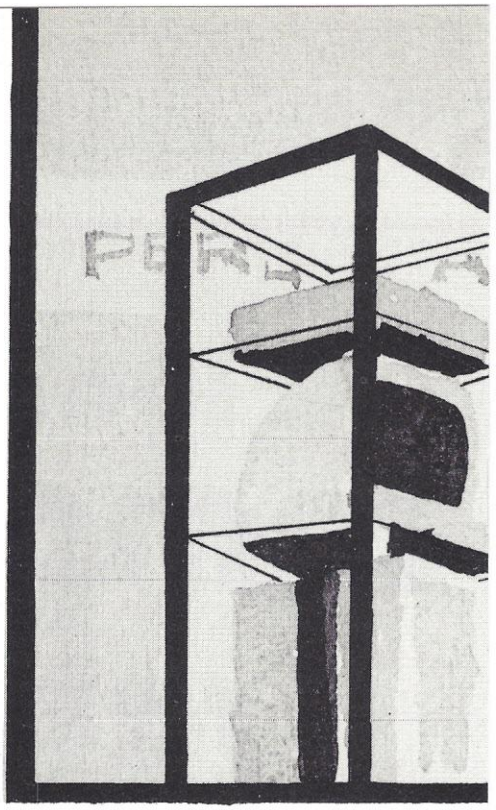
history without a shop in which customers could buy personal computers over the counter.

Within weeks of the Heiser opening, three more stores had started elsewhere in the United States. Within six months, a couple of dozen stores were open. By the end of 1976, at *least* 100 legitimate computer retail stores were operating in this country and estimates of the number ranged as high as 200. A comprehensive list of stores is difficult to generate. (A good, but probably incomplete list can be found on page 132.) For one thing, not all of the "dealers" the manufacturers list are conventional stores. Some are purchasing groups that have successfully demanded significant discounts from manufacturers in return for large orders. No general computer retailing association exists yet to serve store operators and provide information from a central source. The number of stores is growing so rapidly that all tallies are obsolete by the time they can be completed. The number of stores will undoubtedly continue to grow at a high rate for at least two years to come. Ed Roberts of Mits commented that the company has a file with over 2,000 applications for dealerships, of which some fraction are realistic and will grow into operating stores. Mits is adding three or four dealerships a month to its list, as many as it can reasonably hope to supply.

Paul Terrell, originator of the Byte Shops, is franchising retail stores. At last count Terrell said he had 32 stores open, up from 25 when PERSONAL COMPUTING first inquired. (Terrell has enjoyed substantial publicity in major magazines like *Business Week* and *Newsweek*, who considered computer retailing newsworthy when they discovered it. "People compliment me on my foresight in getting into this field," he says, "but I didn't have any foresight. Dick Heiser had it. He opened a store and ran it successfully. I figured I might be able to do that, too; that's how much foresight I had.")

Another franchising organization is Computer Shack – not owned by Tandy Corp., whose Radio Shacks immediately come to mind, but by the folks who own IMS Assoc., manufacturer of the Imsai computer. (Pete Connor's Computer Shack in New Mexico came first and is independent.) Computer Shack's Ed Faber describes the venture as a full-fledged national retailing activity.

Dick Brown and partner Sid Halligan have set up four stores of their own in the East, including one in downtown Manhattan. Jim Bannasch in Chicago is ramrodding development of the Itty-Bitty-Machine Co., which merged recently with Ray Borrill's Data Domains, making an effective chain of seven stores. The Computer Power and Light Co. under Gene Murrow hopes to establish half a dozen company-owned stores, while a number of independently owned Computer Marts are federating loosely to establish a common identity, according to George Tate of the Computer Mart in Orange, Calif. Dan Meyer says that Southwest Technical Products Co., long established as a manufacturer of kits, is opening an experimental retail outlet near its San Antonio plant. (This is partly to learn something about retailing, says Dan, partly to give visitors someplace to go besides the busy plant.) Independent dealers are springing up everywhere, either manufacturing their equipment or buying from manufacturers with non-exclusive dealers.



Hazards in the Field

With all this activity, surely some number of stores will fail. Retailers seem to agree that a major shakeout is due in the field. Some feel it's already happening, but won't affect *them*, knock on wood! Is failure possible? Well, yes.

The primary reason is undercapitalization compounded by poor management. Some shoestring retailers will prosper, but the odds are against them: some problems can be solved only with money. Though some franchisers speak cheerfully of opening a store with as little as $24,000 in capital to cover all business operations *and* inventory, the more common estimate is $50,000 to $100,000. That's a significant chunk of money, more than the little entrepreneur can typically raise in small loans from friends and relatives. (Note that if he tries to sell a little stock to a lot of people, he's likely to find himself strangled in complex federal and state regulations. The legal jungle is frightening for the little guy who just wants to start a modest store selling something he enjoys.)

Selling more product is not always the solution to limited capital – "I don't know of any store that has failed for lack of sales," said one retailer. "Some products simply don't bring in more money than it costs to handle them."

It may seem that a shopkeeper selling a $3000 system should be doing very well indeed, but consider his situation. In this field he's lucky to get a 25% margin. That is, if the retail price of the item is $100, he buys it from the manufacturer for $75. The $25 spread is his margin, out of which must come rent, salary, taxes, etcetera, as well as any profit. That's a terrible margin for any retailer. Most general retail stores operate at margins of 35% to 40%. Even discount department stores in the low rent district get about 30%.

Many manufacturing companies in personal computing are dominated by people who came from the established electronics industry, usually from electronic instruments. Those sales are typically handled through representatives who deal exclusively with businesses. No store fronts for them, no inventory, no long talks with customers who drop in to chat. The reps work out of small offices with small staffs. When electronics manufacturers began pricing their computer products for the retail market, they worked with the same old assumptions.

When one dealer called to complain, a manufacturer said in exasperation: "Don't you know *anything* about the electronics business?" "Sure," said the dealer," but you don't know anything about the retailing business!" A chill fell on their relationship.

Some dealers are earning handsome profits, but it's no cinch. The successful retailer is serving his customers well in spite of skinny margins. Some of the manufacturers are learning the realities of the business and gradually adjusting their pricing to match. This probably

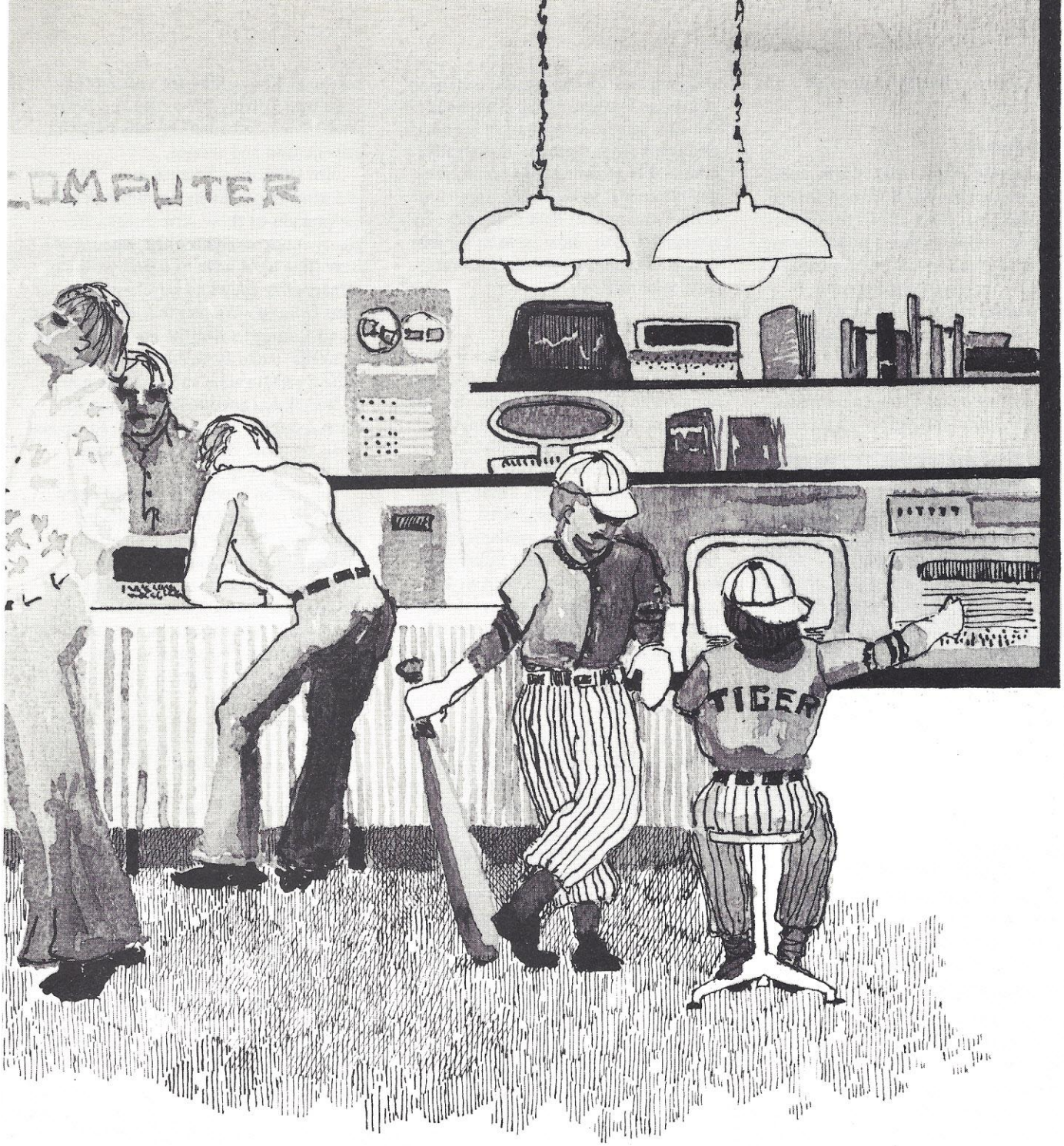


Illustration by Reinord von Whitt-Pritchette

means that retail prices won't be dropping quite as rapidly as wholesale prices, while technology improves and manufacturing costs drop. Are you being ripped off? That depends on what your retail store does for you.

PERSONAL COMPUTING asked retailers just what they think they are doing (or should be doing) to earn the continued trade and loyalty of customers. Who is their market? What do they sell? What is the function of a computer store? What do they expect to happen in the next couple of years? There's remarkably good agreement on the nature of the general market for personal computing systems.

Hardware Hobbyists

Hardware hobbyists are universally recognized as the first significant personal computer market. There are perhaps 200,000 technically able people in this country who are interested in dealing with the computer on a basic technical level. In that group are the people who enjoy speaking octal to the computer, troubleshooting power supply problems and inventing clever new ways to modify the products they buy. They embraced low cost computer kits, filling in the documentation gaps with their own knowledge. They provide a big enough market to encourage more manufacturers to enter the field. The number of hardware hobbyists is finite and they can't be expected to support a broad market, but they are absolutely essential for breaking trail in the development of novel technical systems. Hardware hobbyists also tend to be cantankerous customers for both manufacturer and retailer, pressing hard for more information and performance. The dealers are divided in opinion about the importance of the hardware hobbyist to future development of the market. Some enjoy the hobbyist business, love the tough technical talk and the steady purchases of the hardware people. Other dealers can't or don't want to cope

with them, preferring to develop a different market.

Small Business

A second major market is in small business systems for little companies that want but can't afford the advantages of computer-based bookkeeping, accounting and inventory control offered by the established computer companies. Many of the small business users are almost hobbyists, eager to use the microcomputer systems experimentally. They often develop their own software and extend themselves to learn about computers to get the

Photo courtesy Byte Inc.

The whole object of the business is to buy, and sell, computers at retail over the counter. The cash register is not the least important piece of technical equipment in the store.

systems operating quickly. Not all business systems are used for accounting.

"Personal" computers are being put to work in process control, aircraft load-and-balance calculations and research. For example, a researcher in the southwest had been running fast Fourier transforms on his company's big West Coast computer system. The turnaround time was a full day. He bought a computer kit for his own entertainment, found that he could easily run the transforms on the system, and took the machine to his office for his own use. The turnaround time including conversion of the original data to compatible form is two hours and a few minutes, while the cost in dollars is greatly reduced. (Not surprisingly, the machine is booked solid with work for all of his associates, the company has insisted on buying it from him and he's ordered another kit so he can have a computer of his own again.)

Computer dealers are working increasingly on special small business applications like these. The consensus is that this second-level market is at least two years from maturity as a steady, predictable income-producer. In the meantime it is loaded with opportunities for the retailer to lose his shirt by guaranteeing to make systems do jobs that are theoretically easy but practically very difficult.

Home Computer Users

The eventual major market is the "home computer user," the naive consumer who doesn't even want to know what's inside the box, but wants to use the computer as an appliance, a tool to do some set of tasks. "Three to five years," the retailers usually say, before a system is inexpensive, simple and reliable enough is available to serve that huge market. Cost is a major factor in opening this market. An old rule-of-thumb suggests that when the price of an instrument drops by half, the potential market increases by a factor of eight.

Stuff for Sale

What do the stores sell? That depends on the store. Everybody sells a computer of some kind, usually more than one brand but not *all* brands . . . and the limitation isn't based only on the desire of some manufacturers for exclusive dealerships. Nobody can be highly competent in dealing with all computer systems. It's all a small shop can do to keep up with service and applications information on one major system, let alone half a dozen systems.

And systems they are, because the primary computer offered is supported by add-ons produced by half a dozen different manufacturers who supply RAM and PROM memory, controllers for subsystems, video graphics controllers, speech synthesizers and an array of other products.

Video terminals, cassette memories, disc memories, printers, tape readers and other peripherals are necessary to any general system. The retailer must stock and maintain them.

Every store offers a modest variety of software, programs that will let the computer owner put his system to work. The supply of debugged programs for sale has been painfully limited and retailers long for a break in the drought.

Handholding

Most importantly, stores offer *help*. Larry Chinnery of the Computer Workshop in Rockville, Md. observed that the customer is rewarded for visiting the store by receiving "Pre-sales and post-sales advice, information, information, information and service."

Jim Dunion in Atlanta says: "We act as a kind of ointment, soothing people's feelings about these new things. We greatly underestimated the amount of staff time we'd have to spend with customers *after* they had purchased systems from us. We feel that the store has an obligation to give the customer what he needs ... and he needs a lot. We set aside a certain time each day for a kind of free clinic, encouraging people to bring troubled hardware to us, so we can work on other things at other times. It's hard to keep up."

Education is considered a primary function of stores by every retailer PERSONAL COMPUTING contacted Practically every potential buyer for a car, television set or washing machine knows what the machine does, how to use it and what can be expected of it generally. Potential buyers of personal computers typically don't know any of these things. ("I'm surprised," said one retailer, "at the rather small number of computer professionals who come in here, in spite of the large number of them in our area. It's as if the professionals who deal with software, but never with the computer, and those who deal with hardware, but never programming, are more intimidated by the combination in personal computing than complete outsiders are.") Every potential customer needs education in some aspect of computers.

Some stores run well-attended classes for which they charge reasonable rates. It's a problem, though, to maintain regular personnel and schedules. Classes tend to be displaced by urgent business that seems more important to immediate survival.

Gene Murrow, though, devotes about one-third of his store space to a classroom, where he runs regular classes. "A store should be an educational center," he says, "not just a place to buy things. We're trying to deal chiefly with the 'second-generation hobbyist' who wants the computer to be an interesting tool without idiosyncrasies. The computer should be as reliable as a pet rock. We'd like our store to be like a Yamaha store/music school. When you buy a flute or piano there, you are confident that the instrument works and that if a bad note is produced, it's your fault. Yamaha sells reliable instruments and teaches people how to make music with them. That's what we have in mind."

Terrell allows that the Byte Shops

are like the Stretch-N-Sew shops that provide excellent education in sewing and sell acres of cloth to the increasingly skilled students. If the training were poor and frustrating, the students wouldn't be encouraged to go on. The educational product must be good.

Jim Dunion has a sort of lofty view of the store's overall function in education. It should be a "positive model" for potential computer owners, so they think of their own systems in terms of what they have seen in the store environment and have a good feeling about them.

School of Digital Knocks

Visits to stores all over the country reveals a common feature of which they may or may not be glad. In virtually every store, during virtually all business hours, two or three 13- to 15-year-old kids can be seen huddled around a computer terminal. The kids are ordinarily very serious, concentrating on the keyboard and CRT with great intensity. They work quietly and rapidly, putting the machines through their paces. Usually they are polite and accommodating to the store personnel who have to ease them aside so the systems can be demonstrated to potential customers. Indeed, the youngsters are often the best demonstrators and are developing into the best programmers and hardware wizards in town. Surely these are the special people, the bright, able youth from whose ranks our dazzling technical leaders will be coming in a few years. They're being educated in the stores, finding their own way with occasional guidance from busy elders in a commercial setting. Is this important? Is it happening anywhere else in the world? The traveler begins to look closely at these intent young people, wondering which will be earthshakers in the next decade. Hard to tell by staring at them.

Photo courtesy
Amer. Used Computer Corp.

Do you fit in this picture? Buried in thought, in a corner, surrounded by computers, in the world's largest computer store (Boston).

Fixit

Service is a major function of the stores, of course, and few retailers feel that they've come to grips with the problem. George Tate is mounting a deliberate campaign to become famous as "The Computer Doctor," hoping to establish himself and his associates as *the* national center for personal computer care. An edgy business at best, it's hard to break even on the work, let alone make a profit at what seem to suffering customers like outrageously high hourly rates. Part of the problem is that customers who assemble kits feel, with some justification, that the systems should work as long as they've done everything they were told to do in the instructions. They bring non-functioning units to the computer stores for help and are aggrieved when they're charged for the service. The stores typically eat a lot of this expense on behalf of public relations. (Retailers speak of the "up-front phenomenon" observed by people opening stores in new areas. An hour before the doors open on the first day, a long line forms out front, made up of people who are bringing in their mail-order kits for help.)

A second part of the service problem is that quality control, or the lack of it, has been the curse of the industry. Most of the manufacturers with courage to plunge into a new field with products for an uncertain market were themselves undercapitalized and unfamiliar with the techniques of high-quality, large-scale production. The personal computing field has been for them a giant experiment in survival. Quality is improving dramatically, not only in the hardware itself but in the documentation that goes with it. The dealers are extremely glad of this improvement. "My suppliers work in nice, safe factories," says one, "but that's plate glass on the front of my store. I'm vulnerable when the customers are mad."

Nobody has yet announced a service policy plan covering all ailments of a system for a specified period of time. The idea has been kicked around, but no nobody knows quite how to handle it. Some franchisers are making a big point of service training. "When we let a dealer put up a sign that says 'Authorized Service Representative,' we're going to be sure it means something."

Photo courtesy Computer Power and Light

Not all of the computer stores are tucked away in shopping centers or on side streets. This one fronts on busy Ventura Blvd. in Studio City, Calif.

Many stores, in fact, manufacture products of their own. Computer Power and Light produces its own COMPAL computer system, chiefly, says Murrow, for the sake of quality control. Byte Inc. will be assembling Shugart floppy disc systems for the Byte Shops.

Innovation

This reveals a major factor in the personal computing revolution. The stores are actually centers of technical innovation on an important scale. While it is difficult to manufacture complex systems to high standards in large numbers, it is *not* difficult to manufacture small quantities of special electronics circuit cards to high standards. Many clever customers of computer stores bring inventions to the store owners, looking for support. These inventions are usually interesting circuits assembled from readily available integrated-circuit chips for novel applications, controllers, interfaces, sound synthesizers and the like. Often, the support necessary to get a few boards made up for sale is only a couple of hundred dollars, an amount the store operator can spring for if he is sufficiently intrigued. He offers more than that, of course. He gives the eager inventor/developer/manufacturer a real test market, a way to find out on a small scale whether his product can actually be sold. The risk is tiny for all concerned. The effects may be very large. Indeed, the overall effect on our technology may be very great, because this opportunity for attic inventors to gain public exposure for their crazy products is highly unus-

ual, a fluke of the times. Is it worth preserving? *Can* it be preserved? (Store operators who are not really looking for ratholes down which to drop $200 may be horrified at the very mention of this subject. Don't be surprised if your local dealer snarls at you viciously when you flash your invention at him.)

Miscellany

Dealers almost all detect a trend away from kits toward assembled units, at least in terms of percentage of sales. Sales in general are increasing (a number of stores do over $80,000 in business each month), so kit sales are rising, but the sales of assembled systems seem to be increasing even more rapidly. Everybody would be surprised to see a significant technical breakthrough in the next couple of years. Some dealers do a lot of foreign business in Europe and South America, some in Africa. Some dealers sell as much as 15% of their wares by mail; some have practically no mail-order business. Dealer advertising seems to be spotty and unsystematic. The chain developers advertise nationally in magazines and newsletters. Many local stores buy a little newspaper space, and a few have even tried radio and advertising on buses. Some limit themselves to passing out flyers. "Everything draws," says a dealer. "All advertising seems to work and I can't make any comparisons of one advertising approach with another. The problem is that my store fills up when I advertise, and I quickly run out of stock. These surges wipe me out and people who have to wait for deliveries from my unpredictable suppliers get impatient. It's hard to know what to do."

Now What?

That seems to be the best general summary of computer retailing. It's hard to know what to do, hard for the retailer to determine a sensible course of action, hard for the consumer to make practical recommendations, to vote sensibly with his dollars.

This is a field without statistics. "Back in the early days," a dealer started to say. Then he caught himself. "What am I saying? The early days were less than a year ago!"

Retailers and customers all seem to sense a huge opportunity in this field, not just a chance to make money but an opportunity to do something big, to participate in an exciting movement unique to this last quarter of the 20th century.

Your influence may be very great. How can you best use it for the benefit of us all? See your dealer.

America's most advanced cottage industry

by James J. Blackman

Personal computing enthusiasts look forward to a time when computer systems are mass-market items like television sets, available at low mass-production prices in wonderful variety. It's easy for insiders, dazzled by dramatic growth and excitement, to believe that personal computing is already economically significant. In fact, we've hardly been noticed. We are in the process of creating a market, not merely of feeding product to an existing market of great size.

PERSONAL COMPUTING *asked James J. Blackman of Marquest Inc., a prominent marketing consultant to corporations like Gulf Oil, ARCO, Ambassador International, Spiegel and Aldens, to take a professional look at the personal computing phenomenon and give us some comments. Jim Blackman knows little about computer technology but a great deal about developing markets for products. In this first article, he shares with you his preliminary observations.*

The trouble with marketing a "personal computer" is – it's just not enough like a mousetrap. Selling is so simple in the mousetrap business. Has been since mice began to wander around the house, and the word went out that you could "build a better mousetrap and the world will beat a path to your door."

Before you start building a redoubt against rodents (and maybe even this article), let's clarify. The key word is "simple," not "mousetrap." Mousetraps are simple and singular in purpose. Personal computers are not.

Consumers love simple things. Remember the affectionate way in which they welcomed Pet Rocks into their homes? No – not necessarily for killing mice. Pet Rocks were an instant marketing success because of the value added by a creative marketer who decided to make them fun. And what fun it was when once-dull, dowdy and worthless rocks came alive in the marketplace. Proving that selling prices do not always correlate directly with the intrinsic worth of a product.

Let me contend that "Pong" is something like a chip off the Pet Rock. Put a marketing concept around the little unlovable LSI and the package becomes the nation's hottest new consumer electronic. Why? *Simple!* Nothing to do but hook up to the antenna and enjoy with your friends the vicarious thrill of playing championship tennis – on

television! (What joy — to have, at last, direct control over that damn tube that has for so long had control over you. Now, just touch the lever and the ball bounces the way *you* want it to!)

Few marketers (perhaps 1 or 2 Pet Rock vets) are aware that personal computers are even now big sellers across America. Caution, I don't mean to confuse you. I'm not referring to the handful of computer stores, to Altair or Star Trek. It's really Pong that pulled the plug. Pong, and associated genre, are the progenitors of a whole new consumer race. A race to cash registers.

Soon there will be programmable "games" and all manner of useful peripheral gear for turning the TV set into a personal computing center. Over 95% of American households — rich and poor — have already afforded a television set. And they won't worry about affording additional new accessories with which to make it a more enjoyable (maybe even practical) instrument. That's something you can bank on.

I am awestruck by the things that computer hobbyists are doing at home. Their inventiveness has created America's most advanced cottage industry. Over 80 makers of gear and perhaps 200 retail stores have sprung up — overnight. But, look at tomorrow. This thing is a pretty big baby now, and it's growing uncontrollably. Clearly, the dynamics are there. In my opinion, personal computers are destined to grow quickly into one of America's biggest new industries.

You, the readers of this first computer consumer magazine, are among the enlightened few. I look at you as an "elite corps" of consumers. You have already established an important beachhead. This huge new industry is going to need a great many captains. Now, while the battle lines are still forming, seize the opportunity. Plant your own standards upon the highest ground; program a game plan which is uniquely serving of your personal interests and qualifications. You can not only influence developing products, service and presentations but be able to pay your way with your knowledge and skill.

Many of America's richest and happiest entrepreneurs have done it with their hobbies. You may now have within your grasp a future filled with the fun of your professional hobby.

I think it was "Red" Motley, publisher of *Parade Magazine*, who once said, "Nothing happens until somebody sells something." In my opinion, this appreciation of frontlines' initiative with consumers was the forebear of the "marketing concept" that is now a solid and regularly practiced tenet of America's most successful businesses. The "marketing concept" is simply the idea that it is the prime business of business to create and keep a customer. It is expressed by a corporate orientation to consumers and their wants before making production plans. A profitable plant builds what it knows it can sell. Big inventories which must go looking for outlets are patently unprofitable.

"What to build" is one of the burning questions of this new day in personal computers. Most computer products are manufactured for an OEM market in which someone else takes the finished product to consumers or users. Today few "finished computer products" are in the consumer marketplace.

In my estimate, established manufacturers are finding marketing difficult in the personal computer field. They have begun to experience the difference in consumer marketing versus selling to OEM accounts. Selling *through* dealers to the hobbyist consumer is the new thing. OEM manufacturers with no consumer marketing experience or organization must, I think, acquire these links to the marketplace, soon. If they hope to prosper in this new industry, they must start thinking like retailers, because that's where the action is going to be. When asked by a *Business Week* reporter why Texas Instruments had quietly opened several company-owned retail outlets in America and in Europe, a TI executive stated that the company felt it had to have greater control over the destiny of its products.

It's news when an OEM manufacturer starts moving in retail channels. It's a whole new "marketing mentality," with a brace of new things to manage (i.e., consumer market research, new product designs and packaging, trademarks, national and local co-op advertising, retail pricing strategy, trade discounts, promotional policies, store displays, warranties and field servicing policies, administration, sales, etc., etc.).

As of now, the biggies — such as Texas Instruments and National Semiconductor — are busy filling orders for calculators, digital watches and video games. But, mind your store... they are on their way to personal computers. You may be sure they will be there with finished products and fine packaging, along with the advertising and promotion for making their products easily understood by consumers.

Once again, speaking directly to you members of today's "elite corps" of personal computer enthusiasts — *you* are the reason that retailers are so important. They are the last outpost before the consumer sale is

made. Retailers are important to manufacturers in learning what *you want*. This is true in many fields, but especially in the new effort to market personal computers. Consumers will require a full measure of product and applications knowledge and the assurance of local counsel and service after the sale before plunking down the relatively large sums of money.

Retailing is where the action is now and where it will be in the future, in my opinion. Aside from the retail store outlet, there is also a great opportunity for direct-response marketing via mail-order catalogs. This is an especially viable marketing mode for the seller who wishes to target on a designated segment of consumers. In the early days of the hand-held calculator, Hewlett-Packard went into the mails to engineers and financial executives and sold $20 million worth of its professional model — retailing for nearly $400 each. Direct-mail catalogs and brochures are especially viable to market big-ticket items requiring extensive product information and demonstration.

If I were a member of the elite corps of personal computer users today, I would seriously consider becoming a retailer. I'm sure any dealer will tell you it's a rough business, requiring good sources, choice location, capital investment, guts and much hard work and perseverance. The pioneering dealers of today deserve a great deal of acclaim and success, as they have accepted all the risks of forging a new frontier. But, that's all there is now — only a frontier and a land of opportunity looming on the horizon.

"My store" (I'm really beginning to get into the idea) would show and sell the simple consumer benefits attainable via personal computers. I would hope to have an ample number of manufacturer-supplied units requiring only a power source; I'd certainly have kits and plenty of component hardware for the hard core clientele of hobbyists. But, up front I would feature systems and software and somehow make them more easily understood by the average shopping mall consumer. Also "up front" would be plenty of lower-priced "impulse" items as starters for new customers. I'd have a window full of fascinating things in action, and I'd have Master Charge and BankAmericard credit visibly displayed on the door. Inside, my wondering customers would find familiar merchandise, too. Like television sets, magnetic recorders and players, telephone interconnects, digital timers, thermostats, etc. — all manner of multi-use input and output gear. And a big rack of reading material, disks and tapes.

"My store" would affiliate with personal computing clubs in the community. Naturally, I would offer incentives for club members. I would also be sure that the small businessmen of my territory were aware of commercial applications now latent in personal computers.

As an alternative to finding and financing my own private store location, I would consider making a deal with an already-established high-traffic retailer (probably in a related field of merchandise) to run a special department within his store. Many successful specialty "concessionaires" operate within the discount store field, even in Sears stores. The host store supplies the space and traffic and receives a commission on sales. A caution though: the smart merchant (and therefore the more desirable host location) will have to be sold on you and the potential of your operation before he gives up his dear retailing space. You will need a good plan and an exciting marketing concept. *(Ed. note: see the Lemonade Business Planning Program in this issue.)*

This great new technological evolution really began with the dawning of the "data processing" industry. The potential of "personal processing" is not limited to a few hundred thousand business installations. Its outer limit numbers something over 80 million American households.

With the advent of hand-held calculators, digital watches, video games and microprocessors, the world is just becoming aware of the many fabulous feats which computer technology is capable of producing for them — as individuals. If people feel "dehumanized" by these products, they certainly don't show their concern by refusing to buy them. Properly presented, personal computers are not threatening but warmly welcome.

It's sort of like the fable of Aladdin's lamp, but for real this time. We have the genie in a bottle just waiting to be unleashed by the new masters of tomorrow — you, me and our fellow consumers everywhere.

FUTURE ISSUES

PERSONAL COMPUTING interviewers have carried camera and recorder to Washington, D.C. to talk with Congressman Barry Goldwater, Jr. about the red-hot computer privacy issue and the legislation he's introduced. Will personal computing be repressed by law? See our next issue.

Music is on the mind of computerists and major musical meeting reports are scheduled.

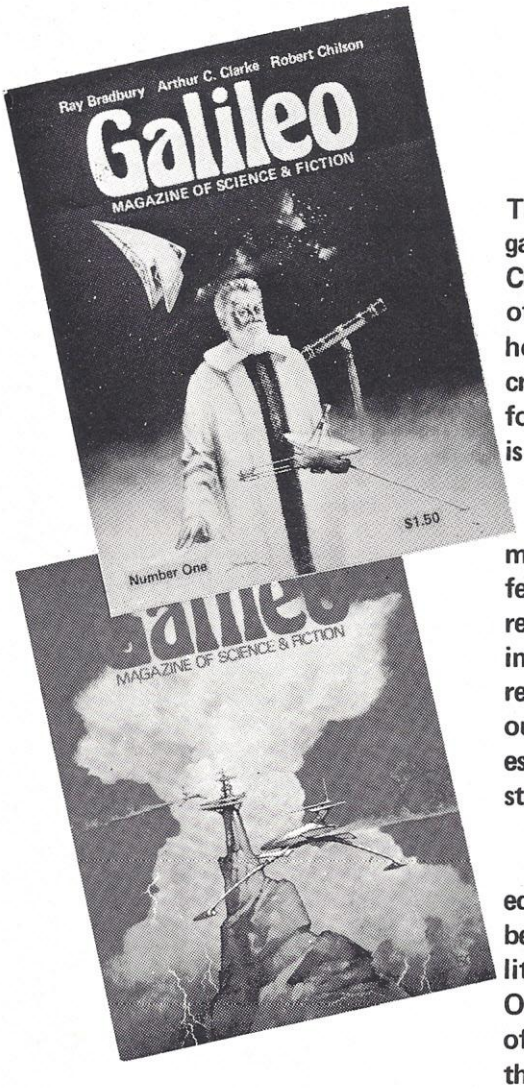
Russ Walter offers a picture of the microprocessor family tree, paying special attention to the vaunted Z-80 and the 6502.

A Buyer's Guide, Part 1, will give the would-be purchaser a look at many of the systems now on the market with a systematic technique for defining one's ideal personal system and selecting it in the marketplace.

Henry Brainerd remembers BESSIE fondly and gives us insights into computer history, while Hughes, Celko, and Hughes explain the techniques of looping in programs.

The Monty Python of the computer industry, John Peers, has paused long enough to give us a visionary's view of computers of the very near future that require no formal programming but do simply what they're told by their operators. Peers' Adam computer is approaching that capability, says he, so Adam will appear (without a fig leaf) in PERSONAL COMPUTING's pages.

THE BEST OF THE FUTURE AVAILABLE NOW...



There is a new direction in the field of Science Fiction. The early period, the time of Gernsback, Burroughs, and robots, gave way to the middle period of interstellar travel, Russell, and Campbell. Now the new wave of authors, led by the most farsighted of the 'old timers', are taking Science Fiction into its young adulthood. Experimentation is now mixed creatively with the tested craftsmanship of the masters. The great work of the past is now the foundation of the future. The best is yet to come, and GALILEO is where you'll find it.

GALILEO is a new science fiction quarterly (destined to be monthly) which will be available only through subscription and a few selected bookshops around the country. Its cost, at $1.50, will reflect the quality of its contents in design, illustration, and most importantly, writing. (Subscribers will, of course, benefit from a reduced cost per copy). The great names we proudly announce on our covers are symbols of the fine works by authors both new and established which we will gather together for each voyage to the stars. An outstanding crew in every issue.

Our intention in publishing GALILEO is to pick up where editors like John W. Campbell left off. Science Fiction is—or should be—quality entertainment AND literature. It is the most important literature of our time, or any time. . . . History teaches, science leads. Our GALILEO offers a vision of mankind's future through the eyes of the poet and the scientist. There can be no true appreciation of the present, or the past, without the perspective of the future.

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WALDO: A NATIONAL SPORT

ANYTHING GOES EXCEPT NAPALM AND OTHER EXCESSES THAT MIGHT DISTURB THE SPECTATORS

By Robert Rossum

'Way back in 1972, only a few foresighted people realized that the personal computing revolution was already shaping up, that full-blown computer technology was about to be set free in the hands of an alert, interested and surprisingly competent general populace.

I was not among the foresighted then when I first published an article proposing development of a sport, built around technology, that might allow scientists and engineers to win some of the respect and support that seemed to accrue naturally to baseball players, soccer heroes and even roller-derby queens.

Recall that technology was on hard times. The crest of excitement in the space programs had passed. Some environmentalists were complaining that technology was fundamentally wicked. Numbers of scientists and engineers who had basked in Apollo's glory were startled to find that the parade had passed them by. They were jobless, confused, uncertain of their self-respect, let alone of popular acclaim.

It seemed both desirable and possible for technologists to attain the admired status of sportsmen in our society. The first step was to outline a sport, a game that would suit the temper of the times and the people.

One cannot suggest offhand the firm, fast rules of a game exploiting technology, but we do know a lot about now popular American spectator sports and that knowledge may serve as a guide.

In our games, the players are most important, the real, live human beings, not their cars, ponies, costumes or equipment. Players are admired for stamina, drive, skill, resourcefulness and for *winning*.

Americans like sports with a lot of action. We're not too crazy about chess as a nation; baseball is about as dull a game as we go for. We like to see people move fast, hit hard and outwit worthy opponents with startling and clever moves.

We like games that are just complicated enough to make us think constantly of the rules and just simple enough so we can all argue with authority about what happens.

We like sports we can play on a sandlot basis. Softball and touch football stir even armchair sportsmen to action. We enjoy team sports in which we can work together without necessarily liking each other.

We like to get out and yell for our side. We like underdogs who perform well in spite of odds against them. We like to see the good guys mix it up.

We like games that allow for lots of statistics. We keep score with a vengeance and we keep it honestly. We count not only our sportsmen's scores, but their calories and girl friends and freckles. And when the sports*women* are at play, we like to see them beat the men.

Can we derive a technical sport from this? Indeed we can, and the more easily now that the personal computing revolution is well in progress.

Let the spectator go to the Astrodome to see our game. He'd notice as he enters that a three-foot golden epoxy ball sits on a low pedestal in the middle of the playing field. The field is symmetrically contoured, with pools, hills, thickets and moats.

At the ends of the field are two windowless cells bearing the emblems of the Red and Blue teams. Television sets are placed all over the stadium where the spectators can see them easily as well as seeing the field itself.

With a fanfare, the six-person teams enter the playing field and examine it for five minutes, trying to get the lay of the land. Then three players from each team go to their cells and step inside. The doors are guarded behind them. The other team members go to pits beneath the raised cells.

The television images now brighten to show the players

. . . A THREE-FOOT
GOLDEN EPOXY BALL
SITS ON A LOW PEDESTAL
IN THE MIDDLE OF THE PLAYING FIELD.

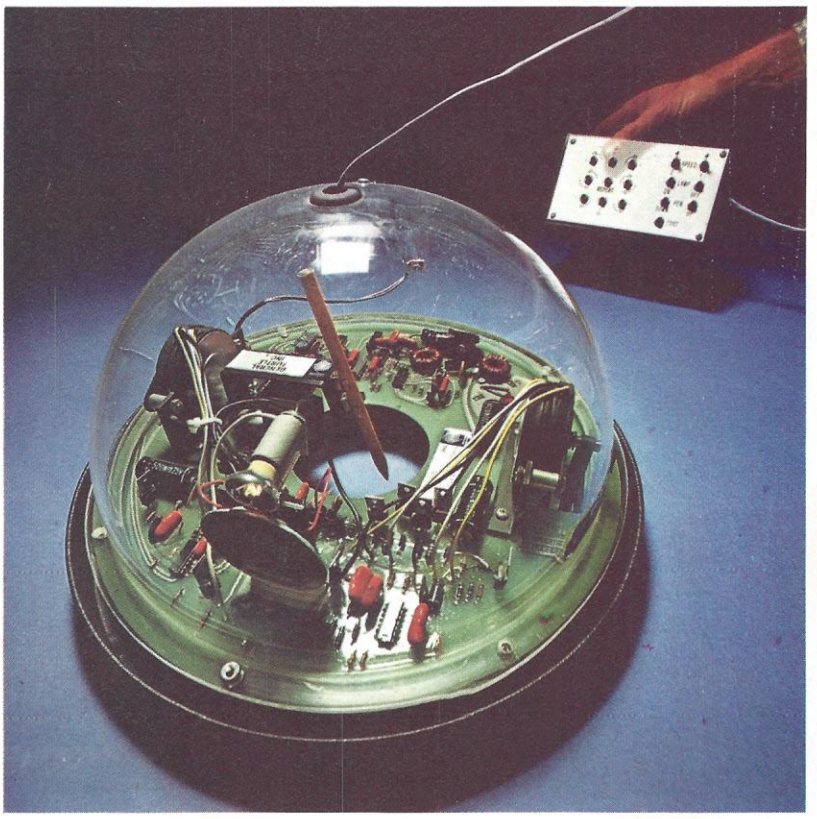
The field is symmetrically contoured, with pools, hills, thickets and moats . . . teams enter the playing field and examine it . . . trying to get the lay of the land.

THE TURTLE, manufactured by General Turtle, is a computer-controlled educational system that might readily be WALDO-adaptable.

Grammer school kids can punch a set of instructions into memory via a keyboard, setting up a pattern of action for the Turtle to follow. Then, before their eyes, this very technical-looking little vehicle follows those instructions, moving about the room, pivoting, blinking its light, tooting its horn, making quite precise and predictable forward and backward moves. That pen held in the middle of the structure can be raised and lowered on command, so that Turtle can leave a trail or draw a picture as it moves over a piece of paper.

For young students, learning surprising things about cause-and-effect and the virtues of planning ahead, the Turtle is a marvelous trainer. It does just what they tell it to do, no better, no worse. It has no mind of its own. The kids control Turtle's destiny completely.

This particular Turtle is owned by the All Indian Pueblo Council in New Mexico, which plans to introduce high technology to small children in the ancient pueblos by using such interesting devices. The hand-held control box in the background was developed by AIPC and is not standard.



With a little more speed and some careful planning, Turtle might become a WALDO champ.

in the cubicles, loosening their collars, sitting down to control consoles, tensely checking switches and displays. The wizard mechanics and technicians in the pits also make their final checks of equipment and trade last-second information.

At the starting signal the teams go into action, hunching over their instruments, reaching for controls. Down under the cells, machines stir to life, then move out onto the irregular terrain of the playing field. The crowd hushes, waiting for contact.

The teams have a single object – possession of the golden ball. The team that can reach out with its machines and pull that ball back to the pit crew will win 70 percent of the purse, while the losers lick their wounds and make their repairs on 30 percent.

Imagine that a modified bulldozer grinds forward from Blue Team, irresistably surmounting all obstacles, plunging through thickets toward the ball. It is relentless, all powerful. But like a fleeting shadow, a small demon sails out from Red Team floating on an air cushion, and dives headlong into the tracks of the Cat. Its titanium snout jams the Cat's gears, while another Red machine strides storklike through a pond toward the ball.

At this, a flock of grabby Blue gadgets flows into the pond to entangle the spindly legs and pull the Red spider, thrashing, into the muck at the bottom of the waters. Then . . .

Anything goes except long-range projectiles, dangerous gases, high explosives, napalm and other excesses that might disturb the spectators. In addition, wisdom suggests it should be illegal to assault the opposing team's control cubicle.

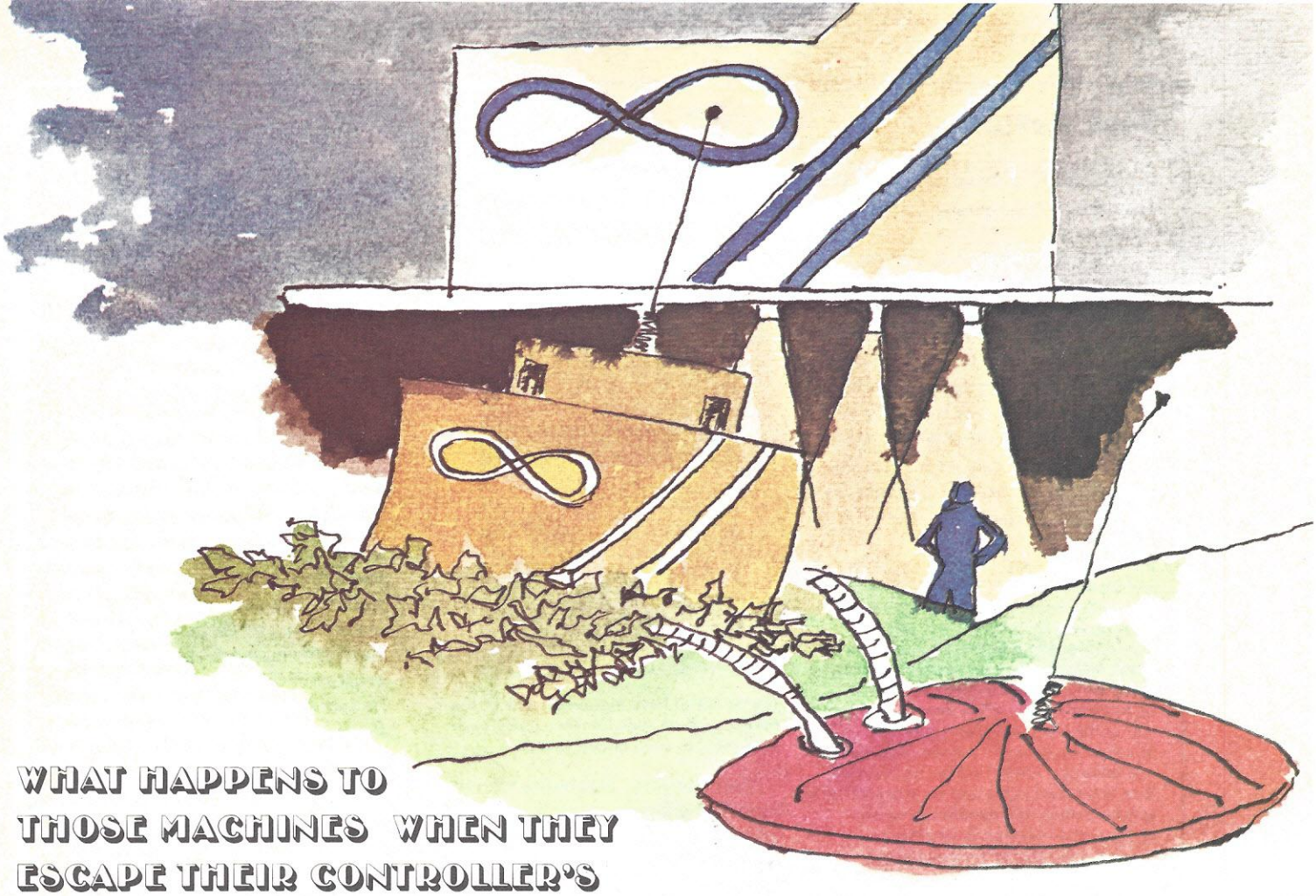
The players control the remote machines from inside the sealed cubicles. They may use radar, sonar, cables, modulated light, television, telepathy, anything they choose for communication and control, so long as it is remote. No human being may enter the playing field.

Teams may use on-line computers, massive data storage systems, programs worked out by large organizations. They may use any technology they can conceive, at any price, but excited human players *must not* run out to help their machines. If their technology fails, they fail.

Each machine on the field is subject to attack from the other side and three men in a box can hand only so many variables at a time. How many? Ah . . . that depends on the sportsmen, the sweating, straining human beings who rely on their knowledge, their hunches, reflexes and coordination to gain the human objective of *winning that game.*

In every game, at almost all times, the real situation will be just a little beyond control, too complicated and unpredictable for inflexible reliance on prepared plans. The players will always take on a bit more than they can handle, straining for the competitive edge. Every spectator knows that they'll lose control of one or more machines in the heat of the struggle.

What happens then? What happens to those machines when they escape their controller's attention for moments



WHAT HAPPENS TO THOSE MACHINES WHEN THEY ESCAPE THEIR CONTROLLER'S ATTENTION FOR MOMENTS OR MINUTES?

That depends on the machine, on the wisdom that the human designers tucked into the mobile package against these times of stressful freedom.

or minutes? That depends on the wisdom that their human designers have tucked into the mobile package against these times of stressful freedom.

A wholly stupid machine will probably perish – if not from attack, then from simple accidents like falling into holes. Free machines might follow a simple policy of lying doggo until the human beings return to their aid. Perhaps they drive toward the golden ball ignoring all else. Perhaps they automatically become hunters, seeking out enemy machines to cling to them, blind their sensors with foam, bog them down, or baffle them with random foolishness.

The free machines must be smart enough to take care of themselves. They will be robots . . . and if the promoters of the games are sensible, the machines will be pleasant-looking, benign, with baby faces and twinkling eyes. No menace to concern the electorate. Ideally, Red Cross symbols and other reassuring signs will be prominent on the vehicles.

The spectator watching the field and the players in the cubicles will root for the home team and boo the opposition. He'll suffer, for damaged machines strain his own muscles as the players tense theirs desperately. He'll be an agitated, cheering spectator at a genuine sporting contest, and he'll itch to play.

When his kid's school challenges another to a match, the Native American Tinkerer will spread his old model airplane and slot car gear out on the kitchen table to try out some ideas. He'll develop coding and control systems, strategies and countermeasures, ploys and jokes. He'll work on invisible paints and antigravity. He'll work on robots, much to his own surprise. Every once in a while, he'll come on with something truly great . . . and he'll do it cheap and dirty, because he's not playing with unlimited tax money, but his own pocket cash.

It's a national trait that we don't just *use* our machines; we work with them on a cooperative basis. The kids who play this game will learn to treat the machines as extensions of their own persons, complete with their flaws and with some of their wisdom.

Apart from playing games, a good man with a machine that multiplies his strength and increases his reach might accomplish many things. He might plant and cultivate and harvest vast crops, might carry the infirm, shelter the helpless. He might defend himself and his. He might do his children and his neighbor great service . . . and he might have an embarrassingly good time the while.

It has been suggested that The Game be named WALDO, after Robert A. Heinlein's classic science-fiction character who developed remote-control systems of spectacular scope. (Indeed, the manipulators with which technicians handle radioactive materials and the like have been called "waldoes" by many for decades.)

A formal organization should distribute information on how to convert rotary lawnmowers to air cushion vehicles, explain the walking wheelchair, examine prosthetic devices

Book Review

BUILD YOUR OWN WORKING ROBOT

David L. Heiserman, Tab Books 1976, Paperback $5.95

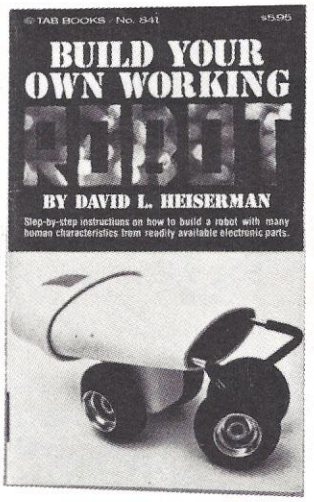
What you see is what you get, a down-to-earth instruction manual. The hobbyist following the step-by-step information builds an electro-mechanical critter like those that have been scuttling around the floors of exotic laboratories for many years, startling visitors and charming staff.

Heiserman speaks of his fabricated pet (named Buster) this way in his preface to the book:

> Buster is a true robot. He is not a toy, and he is not one of the fancy remote-controlled props that have been used in popular science fiction TV shows and movies over the past two decades. He is much more than a toy or a prop. Buster is more like an animal than a machine — he has some basic reflex mechanisms, a will of his own, and even a personality of sorts. He does not merely mimic animal behavior, either; rather, he is a creature in his own right, and he acts and reacts according to a dynamic programming mechanism that is sensitive to his internal and outside environments.

Buster was really not developed in a laboratory and then adapted by the author to hobbyist capabilities. Heiserman actually worked his way up through the system, designing and building it himself from locally available components. The electronic components all came from Radio Shack, whose stores are readily accessible to anybody who may want to build a Buster of his own. Of that the author says in the preface.

> The experimenter planning to build the Buster system ought to have a background in basic electronics, including a familiarization with TTL technology, transistor amplifiers, and elementary control circuits. A working knowledge of Boolean algebra is also important for understanding and troubleshooting some of the more complex circuits. It is equally important to have mastered some of the basic hands-on skills of electronics, such as making printed circuit boards.



Fair warning. Hobbyists who have built Busters report that Heiserman isn't kidding about the need to know what you're doing, that the project is formidable but very rewarding. The more than 230 pages of this book are densely packed with schematics, tables, PC board artwork and illustrations of waveforms.

Having made a point of the difficulty of the project, Heiserman thoughtfully makes it all much easier than it seems at first by developing Buster in the text through three stages that can be taken one at a time. At each stage, the builder can see and appreciate an operating machine with important characteristics.

Heiserman writes in a clear, pleasant, but restrained style, resisting the opportunity in discussion of Buster's philosophy to indulge in flights of fantasy. He's done a good, straight job of presenting real technology in this pioneering book. His personal feelings may run a little deeper than the text indicates, if the dedication of the book is any clue:

> ...to my son Paul and his electronic companion, Buster.

Buster I is the basic mechanical vehicle, a motorized cart that can be operated remotely on an umbilical cord. (Buster I could play WALDO with a good operator at his controls.)

Buster II is equipped to wander by himself, without the umbilical cord, wandering around the house, speeding up when he encounters no obstacles, growing more cautious when his progress is impeded. At this point he's an independent entity whose reflexes override instructions that may be given to him by an operator. That is, an operator can direct Buster remotely, but if the remote instruction is "go forward" and Buster is running into an obstacle, his "Blunder Buster" reflexes will take precedence over the order and he'll feel his way around the obstacle.

Buster III is outfitted with more sophisticated sensors and communications systems. If Buster III gets trapped in a closet, for example, and decides he can't get out, he calls for help. If no help comes in a short while, he shuts most of his systems down, so that his batteries are conserved, and waits patiently for attention. When his batteries are low, Buster III hunts hungrily for his "food tray," a battery charger. He homes in on it and takes nourishment. With audio communications and an array of clever little logic systems, Buster III is a fascinating creature — might be able to play WALDO with-*out* much help.

operated remotely by nerve impulses from the stumps of severed limbs. WALDO needn't start from scratch; all of the necessary technology is at hand, recently augmented by microprocessors and microcomputers. At least one manufacturer now offers a plug-in relay board that any standard small computer can operate in straight-forward fashion to control motors and other devices. Do you suppose a 1949 Hudson can be trained to fetch a stick?

The organization would evolve the rules, methods, mores and traditions embodied in a full-fledged sport, focusing attention firmly on the human team members, the sportsmen and sportswomen, as well as their technological extensions.

Squalor? Hunger? We might have these things only if we chose to keep them for old time's sake. Our scientists and engineers might enjoy both self-respect and popular esteem as the daring risk-takers who oppose these ancient miseries.

'Way back in 1972 this was all a misty pipe dream, a fantasy for the future. The future is here. On with the game. The Sun and the stars are golden balls. Our sportsmen may reach for them from this Blue Planet.

ROBOTS

AN ESTIMATE OF THE STATE OF THE ART, AND AN INVITATION TO PERSONS OF ADVENTUROUS SPIRIT AND INQUIRING MIND

We believe that the key discoveries necessary to the art of robotics have already been made. **We believe** that behind various national borders, behind the doors of various scientific disciplines from biochemistry to microelectronics, all of the primary technical obstacles have been overcome, all feasibilities been proven, all methods become known.

We believe that what remains to be achieved is principally the refinement of systems applying existing technologies — **and that this work proceeds apace.** We believe the world is about to encounter (where? when?) machines that truly simulate the intellectual and physical behavior of human beings: robots.

Robots are on our doorstep. Robots are almost within our reach. And we, within theirs.

Robots are as frightening as they are alluring, as threatening as they are promising. Yet whatever reservation anyone may feel, there is now no turning back, no possibility of their denial or prohibition. The development of artificial intelligence proceeds not only in the laboratories of governments and industries, but also among the thousands of individual amateurs and hobbyists, free citizens exercising their freedom with experiments in the fascinating field of personal computing. **We believe** that since they are possible, robots are inevitable — "for good or ill."

The United States Robotics Society is established "for good" — for the good of mankind — not in opposition, for opposition is idle, and not in advocacy, for advocacy is unnecessary. **We invite** the support and active participation of all persons who can face the Age of the Robot with the appropriate curiosity and spirit of adventure.

Intelligent machines for production and service — tireless, able to understand commands and carry them out sensibly without feeling a need to make policy for themselves — may become the long-heralded boon to humanity, lifting ancient burdens of toil and suffering. But if they were to be developed "in the dark" — if they were to be sprung upon us full-blown, without our preparation — the reaction might be disastrous. The survival of our own society may depend quite soon (how soon?) on our ability to deal even with "friendly" robots. If we ignore them, if we are incompetent in their fields, we are surely not serving our own interests.

Intelligent weapons now appear practicable within the next decade or two — systems, for example, that can differentiate between friend and foe automatically, through their own sensors and judgement. If such weapons are developed anywhere in the world, they will be extraordinarily dangerous to any society which has not learned how to deal with them.

Robotics has charm not only for trained technicians and professionals but also for millions of persons without the skills and resources to participate directly in the work. Communication about robotics, like robots themselves, is inevitable, — through publicity, rumor, espionage, and now through The United States Robotics Society. This organization will assume the important task of identifying discoveries, gathering supporting data from the hidden recesses where they rest, collating, publishing, becoming a center of information for all parties seeking knowledge of current and historical activity in robotics. We urge you to be one of us — for just $12/year.

Benefits to USRS Members Growing Year by Year

- Certificate of Registration as USRS Member.
- USRS Newsletter, USRS bulletins, other correspondence from the Society as occasion demands.
- Aid in contacting other USRS Members in home regions, toward establishing USRS events.
- Opportunity (Qualified) to officiate as USRS Representative at Regional and National robotics shows and exercises.
- Service (Optional) as USRS Contributing Correspondent.
- Participation in the determination of procedures for investigating, reporting, archiving, and disseminating information relevant to robotics . . . and
- Privileged access to the Library of Robotics to be established by USRS.
- Discounts as may from time to time be arranged by USRS on behalf of members — with publishers, manufacturers/distributors of robotics related materials. (Note: this benefit alone can be expected to repay the moderate USRS Membership costs many times over.)

United States Robotics Society

A Non-Profit Organization
Glenn R. Norris, President
Box 26484 Albuquerque,
New Mexico 87102

Application for Charter Membership

USRS

United States Robotics Society
Box 26484 Albuquerque, NM 87102

Enclosed is my check for $12 for enrollment and first-year dues.

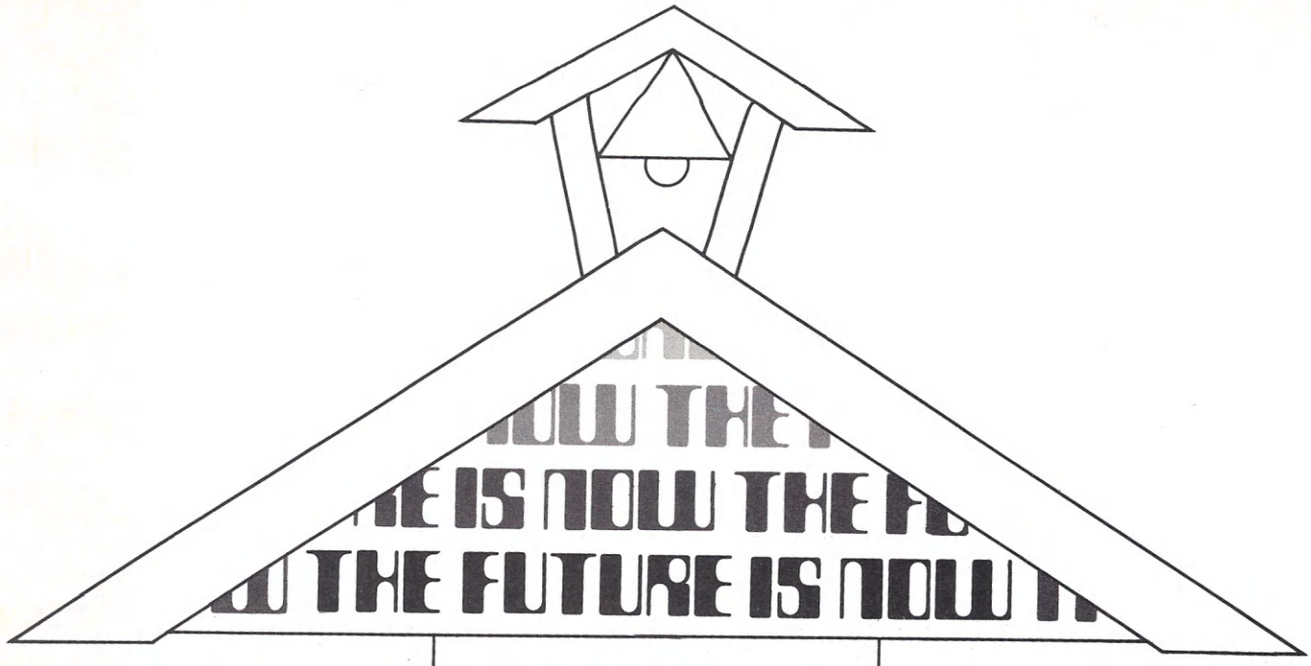
The following information is requested (OPTIONAL) to help ensure your full participation in the benefits of the Society.

My interest in robotics derives from ( )intellectual curiosity ( )academic training ( ) professional/business

Please tell us more: _____

( ) I am interested in joining with others in local USRS activity.
I might serve as ( ) Correspondent ( ) Official at USRS functions.

NAME _____
ADDRESS FOR USRS
COMMUNICATIONS _____ CITY _____ STATE _____ ZIP _____ PHONE _____



by Peter Grimes

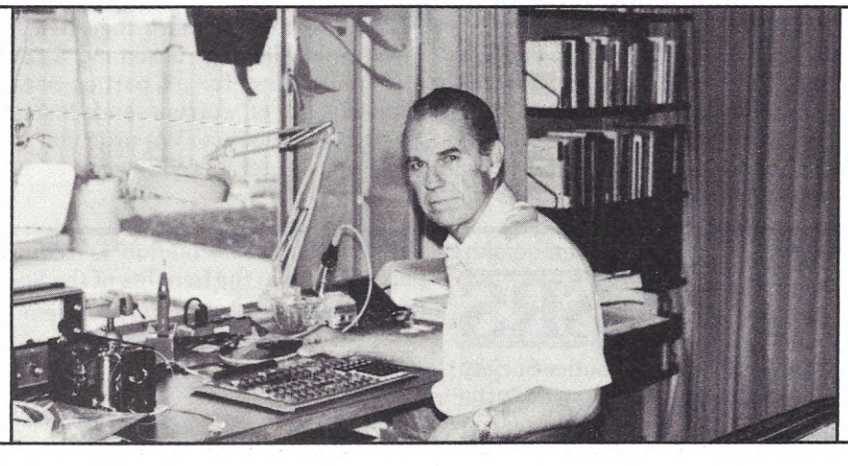
The San Jose Schools discovered the microcomputer only about a year ago — and San Jose's history of the wild time since then is the future of educators discovering the personal computers now. Hold tight! Here's what it was/will be like . . .

Four short years ago San Jose Unified School District purchased its first computer system. It was a Digital Equipment Corp. PDP-8E which, after some expansion, offered five high schools and two junior high schools one port each for instruction in BASIC programming using ASR-33 remote Teletype terminals. Although San Jose Schools is a large district (14 secondary schools, 37 elementary schools and almost 40,000 students), this small computer system was a major investment, with 50 percent of the initial cost supplied by matching Federal funds.

San Jose lies in the heart of California's Santa Clara Valley (also colloquially known as Silicon Valley, for the many semiconductor manufacturers there). While the valley is an international center for research and development in digital electronics, this fact did not help the schools much. Even near the fountainhead, small minicomputer systems were not given away. They cost money, lots of it, and our school system like most others has a record for frugality in capital outlay. The PDP-8 was at least a start. Our secondary math teachers learned BASIC, and our high schools started to offer classes in programming using minicalculators, programmable desk top calculators and their one-and-only remote Teletype terminal. It was a rather low-key effort but tremendously important in retrospect, because it developed the background for what we are doing today.

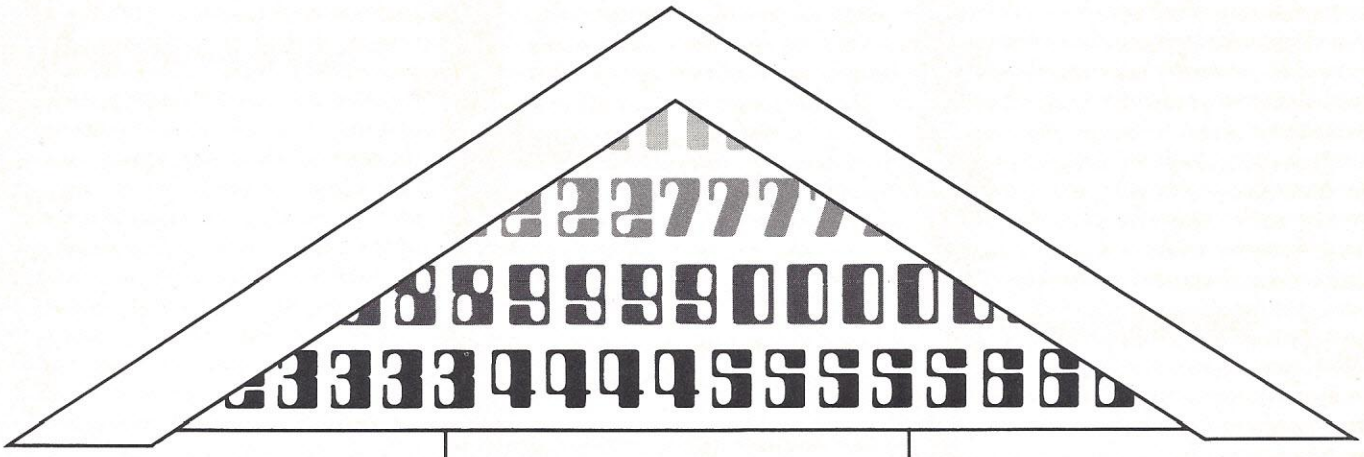
Then, in 1975, lightning struck! Stimulated by falling prices, goaded by the newly adopted State of California Mathematics Framework (the framework included a computer strand for the first time), hounded by teachers demanding more computer facilities and encouraged by a cooperative administration and school board, we began to investigate upgrading our PDP-8E system to serve more users. We immediately found that we would need close to $50,000 to upgrade our DEC system to 16-20 users, far beyond any support we could reasonably expect. We thought, "Where do we go from here?" With an unparalleled opportunity to pursue something we considered important, perseverance was the order of the day. High cost was very discouraging and we were then unaware of the rapid rise of the hobby computer represented by Mits's Altair 8800.

Bob Albrecht of People's Computer Co. (PCC) came to our rescue. Hearing of our plight (money to spend and no satisfactory way of spending it), Bob suggested in November 1975, that we look into microcomputers. We did and things have not been the same since. PCC, by the way, is a non-profit cor-



The author at his personal computer. Supervisor, science and mathematics, of the San Jose schools, he will give each senior high a 12K computer and each junior high an 8K.

FUTURE COMPUTING



poration promoting school and hobby computing. Our program is in part an example of their good work.

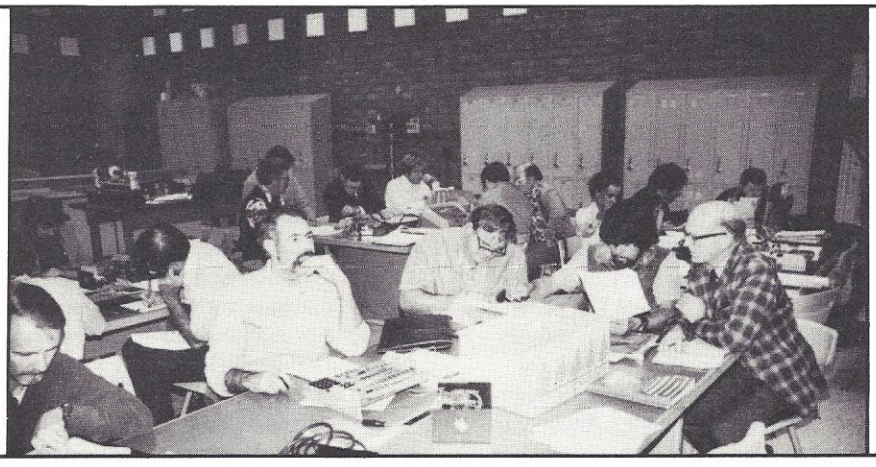
In the spring of 1976, our mathematics and science teachers made a massive effort to become informed about the microprocessor and its associated electronics. We learned for the first time that we could buy LSI-based general purpose microcomputers an order of magnitude less costly than the "inexpensive" minicomputer we had bought just a few years earlier. We found that we could learn a lot and save even more money by assembling our own microcomputer components. We were awed by the fact that $140 would give us 4K of highly reliable semiconductor memory as contrasted to $3,000 for the same amount of core memory four years earlier. And we found that the new technology was spawning a computer hobby market unparalleled in the history of technology in its speed of development. (The spring and summer of 1976 saw the opening of over one dozen computer hobby shops in the San Francisco Bay Area alone.)

> "We were awed by the fact that $140 would give us 4K of memory as contrasted to $3,000 for the same amount four years earlier."

Confronted with this information and having already witnessed the impact of minicalculators and solid-state clocks and watches, we rapidly came to two significant conclusions: (1) we could afford computers in our classrooms after all and (2) the pending widespread presence and availability of microcomputers (within five years, certainly within ten) would create an enormous need for a variety of computer programming and technological skills among young people.

Extending our logic, we concluded that the slow development of computer programming and computer science courses in the secondary curriculum would undergo explosive growth. College prep students of all sorts would require sophisticated computer skills, and computer related careers would require dramatic emphasis in the secondary curriculum. Inevitably, microprocessors would revolutionize almost every facet of everyday life, and a case could be made that digital electronics, computer technology, and data and word processing would soon become as relevant in the high school curriculum as science, mathematics, business, English, history, government and all the other subjects.

With our facts and conclusions in mind, we set out to determine which of the available microcomputers would best fill our needs at a price that was consistent with the new technology. We determined that the Imsai 8080 machine (Imsai Manufacturing Corp., San Leandro, Calif.) was a quality



In a microcomputer workshop, San Jose teachers try to get at least one step ahead of the students they'll be guiding in computer studies.

product of local manufacture. For about $2,000 assembled, we could have 12K of core memory and a serial I/O with an excellent cabinet, front panel and power supply more than adequate for future expansion. For $1,200 we could assemble our own machine (which a number of teachers did). The other feature of the Imsai 8080 which strongly appealed to us was the fact that it had adopted the Altair bus and board size. Our study had also revealed that small firms offered many attractive board options that were plug-in compatible with both the Imsai and Altair. In addition, Imsai provided 4K and 8K BASIC interpreters and a system editor and assembler at no additional cost.

To test our selection, the school district purchased an Imsai 8080 machine and installed it in the new Castillero Junior High School. Placed in operation in April 1976, the machine has run continuously ever since without a single failure as of this writing (December 1976). Moreover, the machine functioned as advertised, and met all our instructional criteria.

The next step was to plan a purchase program that would reasonably meet our 1976-77 needs within the budgeted amount of money available. We felt that a reasonable goal would be the installation of one microcomputer with Teletype terminal in each of our 14 junior and senior high schools. The junior high machines would have 8K of core and use 4K BASIC while the senior high machines would have 12K of core accommodating 8K BASIC (and eventually the system assembler and editor). With the DEC system, this would give every high school at least two terminals and every junior high school one terminal. While seemingly a small effort, this combined with minicalculators and programmable desk-top calculators to provide the resources necessary to support computer programming electives in each high school and assure the introduction of computer concepts as an adjunct to the entire secondary mathematics curriculum.

The machines are being delivered and installed. To date we have purchased 11 microcomputers, all Imsai 8080's except for one, a Polymorphic 8080 microcomputer which we will use in our elementary program in grades 4-5-6. (The Polymorphic machine does not have a front panel; access to the system is entirely through the terminal keyboard.) We are also experimenting with a few CRT terminals with audio cassette I/O. While we still feel it is important to have the paper-tape facility of the ASR-33 Teletype, high maintenance costs and down time associated with electromechanical devices suggest that we seek an electronic alternative. Of the 11 microcomputers purchased, four teachers and the author of this article assembled five; the other six machines were purchased assembled. Much to our pleasure and surprise, we had remarkably little trouble, and most of our debugging was handled by telephone.

What next? We are building toward the introduction of computer science electives in our high schools by the 1978-79 school year. Sooner than that date, our teachers must be knowledgable about assembly programming, machine-level programming, microprocessors, microcomputer structure and function, input-output, binary, octal, hexadecimal and binary coded number systems, and computer arithmetic. With this in mind, we planned two series of workshops, one in the fall and another in the spring, jointly sponsored by San Jose Schools, San Jose State University and People's Computer Co. Starting in October, we have been meeting after school on consecutive Monday afternoons for two-hour sessions. Thirty-two teachers and all our secondary schools are involved (we have about 100 secondary science and mathematics teachers in the district). To date we have completed the assembly of a small microcomputer called the Data Handler, and are well into machine-level programming.

"Microcomputing concepts should be learned as general principles."

Selling at under $200, the Data Handler is manufactured by Western Data Systems of Santa Clara, Calif. and features the MOS Technology 6502 microprocessor. It has hexidecimal keyboard input and LED output, comes with 1K of RAM memory and incorporates two 8-bit parallel I/O ports. The Data Handler also has a 100-pin Altair/Imsai compatible socket for add-ons and requires a separate regulated 5-volt power supply. Every participating school purchased one Data Handler for each two teachers with the intent of using the microcomputer for student instruction as well as teacher inservice. We have found the Data Handler and MOS Technology's 6500 programming and hardware manuals to be superb resources for teachers who are computer novices. Our experience in this regard, by the way, is significant because most microcomputer instructional materials are not geared to the understanding of secondary school teachers.

Some have asked why we chose a 6502 based microcomputer as a training device while installing 8080 general purpose microcomputers in our schools. One reason was practical. The Data Handler and power supply cost just under $200. Another reason was the instructional qualities of the Data Handler itself. It is a remarkably good machine with which to learn the fundamentals. Third, the architecture and instruction set of the 6502 microprocessor are ideal for beginning programmers. Finally, we were convinced that it would be a mistake to base our learning on the specifics of one particular microprocessor. We felt that microcomputing concepts should be learned as general principles and that definitive differences between microprocessors were rather unimportant to the generalist school teacher.

What about the future? Within the next several years, we will focus on three objectives: (1) computer awareness for a large number of students, (2) computer programming and (3) computer science. As our computer resources expand, allowing more and more student contacts, computer concepts will rapidly invade our mathematics curriculum, accomplishing our first objective. We already offer computer programming electives. These are bound to prosper. And computer science electives will be added to our high school curriculum in one or two years. Lower priority objectives which will take longer to accomplish include more substantial computer orientation instruction in the upper elementary grades and the extension of computer usage into other secondary subjects such as science, business and social studies. (We have been waiting for years to acquire the computer power to develop simulation and gaming techniques in a wide variety of subject areas over a broad range of age and sophistication levels.)

Do we have any advice for our fellow educators? You bet! That big world out there is going to be oriented around computers. The future is now and we had all better become involved – soon!

MICROTREK

With this issue of PERSONAL COMPUTING, we are merging Microtrek—the Microcomputer Magazine for the Hobbyist—into our pages, believing that this will handsomely serve our readers.

A difficulty in producing a magazine like ours is the need to be "all things to all men." As a beginner develops new competence, he loses interest in elementary explanations. We'd like to lead him along to higher-level technology without abandoning beginners who still need basic help. Microtrek is one answer to the problem.

Wes Schneider began publication of Microtrek to provide a good, tight technical journal, outstandingly useful to those who have already got their technical feet wet in computing. The magazine has featured program listings, hardware schematics, solid how-to features for the reader interested primarily in implementing projects already specified.

As a section in PERSONAL COMPUTING, Microtrek will continue this function, augmented by Games and other features. Computer beginners will find some of this material baffling but fascinating and increasingly useful as their knowledge increases. More advanced computer users will revel in the technology.

Welcome to Microtrek. We hope you enjoy it.

Subsystem "B" makes the computer you already have work almost as well as a new Sol-20.

Add it now, and for a limited time we'll throw in a new module with 2048 bytes of preprogrammed PROM or ROM and 1024 bytes of RAM memory free!

Processor Technology's Subsystem "B" puts together the major system elements you need to get your Altair or IMSAI up and running.

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Tape Cassette I/O	CUTS	CUTS	CUTS
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CIRCLE 25

What Computer Clubs Say

Computer clubs around the country have been sending us their newsletters. Here's what they say.

Boston's *Computerist*

If your friend bought some copyrighted software, the law says you can't copy it. In the *Computerist's* August issue, Calvin Mooers urged hobbyists to obey the law and not steal copyrighted software. But in September's issue, Michael Rivers complained about the selfishness of the "Circle C Ranch" and told hobbyists, "Jump them fences!"

In October, Roger Garrett said, "I hope Rivers is not advocating that we distribute copyrighted material without the permission of the author. People who have taken the time and expense to write software such as BASIC for the hobbyist have every right to charge for their work and to protect it by copyright." In November, Herb Grosch added, "Rustlin' is still rustlin': stealin', that's what! And if they catch rustlers, they string 'em up – and the folks in town that have been eatin' cheap beef will come to the hanging and cheer. Stealing software is as bad as going into a Byte Shop and shoplifting."

Rivers replied, "The copyright law is a blessing to this country. It is, however, subject to abuse by profiteering money-grubbers. Clubs helping each other like the hams do is the route we should take. Not living in fear that some Feds are going to collar us for using some creep's software. Success in the home computer field hinges on easy data communications. If we're going to go after anyone, let it be Ma Bell."

"How I Solved My Hard Copy Problem" explains how R. D. Grappel bought an electrostatic printer with speeds up to 1200 baud for "only $300." After praising it, he says the manufacturer "has folded" because the machine is almost impossible to repair if it breaks down. Another disadvantage is, "It stinks! Literally! Since sparks are being discharged into the paper, there is a distinctive odor." But he says, "The machine has needed fixing only once. You might find it good for your hard copy needs too. Just hold your nose when it is printing!"

You could have been a winner – easily. The *Computerist* held an essay contest on "How I Justified My Personal Computer to My Spouse." Nobody entered.

The many clubs in New England (the New England Computer Society, the Greater Boston Computer Group, the Rhode Island Computer Hobbyist Club, the New Hampshire Computer Society, the Southern New England Computer Society and the Westchester-Fairfield Amateur Computer Society) put their announcements in the *Computerist.* Send $6 for a yearly subscription to the *Computerist*, Robert M. Tripp, Box 3, So. Chelmsford, Mass. 01824.

Rochester's *Memory Pages*

Memory Pages serves the Rams (Rochester Area Microcomputer Society), which is changing. The president says, "I've had calls from people expressing lack of enthusiasm for the manufacturers talks we have been having, so we are arranging talks by members concerning their personal experiences." Each meeting will be preceded by a "demo hour," where people can demonstrate items for sale.

How can a club increase its membership? Rams talked to the local chapter of the Association for Computing Machinery; each organization will publicize the other's meetings.

Rams wants to exchange newsletters with other clubs and wants clubs to band together to muscle group purchase power and organize computer fests. To join Rams and get *Memory Pages*, send $5 for an annual subscription to Box D, Rochester, N.Y. 14609.

Houston's *Nybble*

Here are some nybbles from *Nybble.*

"For sale: Altair 8800, $250."

"Ours is not a political party that needs to operate in a smoke-filled room. So please leave the cancer sticks at home, gang."

"Be courteous. Lecturers do not come to the meetings to be told a particular chip will do the function they are describing, nor to be told their program will not work under certain specified conditions. Such interruptions during a lecture serve only to confuse us. Point these out to him after the lecture."

"If you can show just cause why Pat McGee should not assume the Vice Presidency, speak at the next meeting or forever hold your data!"

"Next meeting's topic will be Trash (Totally Recursive Alphanumeric String Handler), a language David Fogg and Pat McGee are developing for the 8080. Based on Trak, it will be a language its authors prefer over BASIC."

"We have 55 paid members. Houston is a city of almost two million. Surely more than 55 people are interested in computers in Houston. Where are they? Perhaps they can

best be accounted for by a statement made to me by a prospective member: 'The club must be the best kept secret in Houston.' We don't advertise, folks; no one knows about us!"

The Houston Amateur Microcomputer Club is at 6513 Jackwood, Houston, Tex. 77074.

Seattle's *Northwest*

Did you know that a nanosecond is about a light-foot?

That's one of the many goodies from the *Northwest Computer Club*, a cheery group. It invited members to "Interpret a Pizza! We're meeting at Vince's Italian Restaurant...." In the next newsletter the editor said, "The pizza meeting lacked pizazz; about 20 people showed up. I guess purely social meetings don't draw well."

The club managed to get a colorful speaker: Bill Gates, president of Micro-Soft, the company that wrote the five Mits BASIC interpreters (4K, 8K, extended, disk and 680). Micro-Soft is developing further enhancements (matrix operations, a Resequence command and double-precision scientific functions), a true compiler, timesharing and APL.

Micro-Soft's "8K" versions for the Intel 8080, Motorola 6800 and MOS Technology 6502 have roughly the same powers. "Bill made some interesting comparisons among these chips. The 6800 version is 600 bytes longer but runs 40% faster than the 8080 version on a normal 6800 (Mits' Altair 680 system runs half as fast as normal). Bill explained that work-horse instructions like JUMP are much faster on the 6800. The 6502 version is 2500 bytes longer and runs 20% faster than the 8080; programming had to be trickier."

Bill claimed his software was better than his competitors'. He said Processor Technology's BASIC takes 6K to do the equivalent of Altair 4K; Imsai's just-released 8K version isn't debugged yet; Sphere's "Basic I" is very slow, since it's a Hewlett-Packard BASIC interpreter using a 6800 simulation of the Hewlett-Packard instruction set; and Ryan McPherson's portable BASIC is slow and requires 24K. His competitors weren't given a chance to reply at that meeting.

Bill covered other languages too. He said his APL would be finished by Christmas '76; Processor Technology has 8080 Focal; New Jersey's Amateur Computer Group is distributing "SPL," a String Processing Language resembling Trac; Intel's resident PL/M is coming soon; and the 8080 version of FORTRAN requires 16K and is expensive and filled with bugs. Will the club let his competitors reply?

Ever hear of a "community information system"? The club says, "The first computer community memory experiment occurred in the San Francisco area several years ago. Resource One, a non-profit group, put five terminals in the Bay area running a keyword retrieval system. The idea was a success: musicians found new band members by using a terminal in a Berkeley record shop; a multiple-author story based on Firesign Theater evolved; cars were sold and babysitters found. The project finally died due to lack of money.

"Peter and Trudy Jounson-Lenz have used their terminal and donated computer time to process a questionnaire for Lake Oswego, Ore. Neighbors drop in to search the data base for nearby people with skills to trade or common interests. The APL program they developed is very flexible in generating reports. A program description is available for $1 and a SASE (695 Fifth Ave., Lake Oswego, Ore. 97034).

"The Cruncher, designed by Lee Felsenstein, is undergoing final development. It operates out of a van, using an LSI-11 based keyword retrieval system operating in batch mode. The van will set up in a rural area, have several terminals and receive items from community members. Later in the day, the system 'crunches' the data, producing directories organized by keyword and given to the community for distribution. More information is available from the Journal of Community Communications, 1807 Delaware St., Berkeley, Calif. 94703. Include 24 cents postage."

The club's newsletter reports other community information systems, tutors you on computer jargon and 8080 programming, runs programming contests, compares local dealers and each month gives 25 reports on new hardware, software and "printware" (publications). For annual subscription and membership send $5 to Northwest Computer Club's new address, Box 242, Renton, Wash. 98055.

Sacramento's *Push & Pop*

What happens at a typical computer club meeting? *Push & Pop* explains:

"The club is an informal forum where computer hobbyists gather to discuss their views, problems and new information in the field of personal computing. It is where new hobbyists learn from the mistakes of seasoned (one or two year) veterans so the neophytes don't reinvent the wheel.

"We normally have one or two speakers, followed by a question and answer period. Then we have a short AC-DC period (Advertisements and Commercials from Distributors and Commercialists), to tell members where they can locally get products, equipment and systems and to create discounts and price breaks for members. After final announcements, we go into our Random Access period, where individuals can obtain personal information and help from the others."

For a year of *Push & Pop* send $5 to Smug (Sacramento Microcomputer Users Group), Box 161513, Sacramento, Calif. 95816.

Stanford's *Homebrew*

Of the many computer clubs throughout the country, Stanford's *Homebrew Computer Club* is one of the most famous.

Its September 15 issue reported, "A local electronics firm has recently announced a computer program that virtually eliminates lost time due to malfunction of computer components. Called OREMA (from the Latin 'Oremus,' meaning 'Let us pray'), the program offers prayers at selected intervals for the continued integrity of memory units and other elements subject to depravity.

"Liturgical in structure, OREMA uses standard petitions and intercessions stored on magnetic tape in Latin, Hebrew and FORTRAN. It holds regular maintenance services thrice daily on automatic cycle; operator intervention is required only for mounting tapes and making responses such as 'Amen' of 'And with thy spirit' on the console typewriter.

"Prayers in Hebrew and FORTRAN are offered directly to the CPU, but Latin prayers may go to peripheral equipment for transfer to the CPU by internal subroutines. Classified prayer reels are available for Government installations."

What is Tom Pittman's "Tiny Basic"? Programmers usually consider it to be less than BASIC: it doesn't allow decimal points, subscripts, string variables, DATA, or numbers larger than 32767; its sole attraction is that it requires less memory. But Tom Pittman wrote a rebuttal in the October 29 issue. He shows how Tiny Basic *can* do all the things big BASIC can, if you're willing to use Tiny Basic's USR function, which dips you into assembly language subroutines.

In one way, Tiny Basic is even superior: it lets you put

arbitrary expressions after the words GO TO and GO SUB. For example, you can say GO TO 2*N+7. Tom shows how those expressions eliminate the need for ON...GO TO and ON...GO SUB.

"The Complete and Utter Idiot's Guide to Computer Programming", by Newett Awl, is *Homebrew's* tutorial column. *Homebrew* also reports new computer clubs around the world (British Columbia, Japan and New Zealand, for example), praises *Dr. Dobb's Journal of Computer Calisthenics and Orthodonthia* and advertises Kentucky Fried Computers in Berzerkeley, Calif. A subscription costs whatever you wish; send your donation to *Homebrew Computer Club Newsletter,* Box 626, Mountain View, Calif. 94042.

San Diego's *Personal Systems*

If you can't afford to subscribe to all these newsletters, start with *Personal Systems,* which reprints articles from the others alongside its own. The December issue reprinted this true story written by Terry O'Brien for Trace (Toronto Region Assoc. of Computer Enthusiasts):

One morning I said to my wife (we were still speaking at that time), "Hey, I'd like to build my own computer system."

"Sure. How many eggs would you like?"

"Could you imagine how neat it would be to have your own computer system right here in the basement?"

"Sure. How many strips of bacon?"

"There's this company in New Mexico selling a complete computer kit for just a few dollars."

"Have you paid the phone bill yet?"

"I think I'd like to buy one."

"What do you want a computer for?"

I paused to think.

"Well? What do you want a computer for?" Her eyes didn't blink.

"Because it would be really neat."

"Well, your birthday is coming up in February. I was going to buy you a shirt, but I suppose I could buy you a computer instead. How much is it?"

I looked at her awkwardly.

My computer arrived in February in a large box. I rushed it down to the basement and carefully unpacked everything. She peered over my shoulder and told me it didn't look like a computer.

"What's this?" she asked, pointing to a small tubular object with colored rings around it.

"That's a resistor."

"What does it do?"

"It stops electricity from passing through it."

"Why don't you just leave the switch off instead?"

I didn't know. I started reading the manuals and assembling the unit. Three weeks later, the moment of truth finally arrived. I called her down. She had to see this. I was tingling with excitement. I pushed the plug into the wall; my hand reached for the switch labeled ON. She looked at me, and her eyes met mine. I pushed the switch up and a puff of black smoke appeared. I said in a very loud voice, "Oh...."

To find out why Terry O'Brien got black smoke, contact his Toronto club or read the reprint in San Diego's *Personal Systems* ($10/year, Membership Committee, San Diego Computer Society, Box 9988, San Diego, Calif. 92109).

Share the good news — tell us what your club is doing.

THE UNGAME

by Kenneth Jackman

This article will give you a taste of two incredible techniques for eking out the intelligence of your personal computing system. It is an appetizer. Preparation of the feast is left to you.

The first technique handles problems like this: you want to write a program to do job X, but you don't know how because there are certain tasks with which you cannot cope. You could write the program to do X, if only you had a subroutine Z that would do the tasks. You know how to do tasks in primitive cases but not in more complicated cases. And in complicated cases you know how to split the task into two simpler (though not necessarily primitive) tasks.

The technique is this. Write the program to do X, assuming that you already have subroutine Z. Your program calls the (still nonexistent) subroutine as often as necessary. Now, how do you write Z? Simple. First, Z checks whether the task is primitive or not. If so, it does the task directly. If not, it splits the task into two simpler tasks. Then to do the tasks, it calls subroutine Z twice. One call for each task. "Wait," you say. "Subroutine Z is calling subroutine Z. It's calling its own self to help do a task because it doesn't know how to do the task by itself? Crazy!"

It's crazy all right. Like a fox. And it's inhuman. But the computer is not human. In fact, the computer is good at using inhuman methods to solve intractable problems. Anyway, the important thing is that with proper attention to details the method works. The tasks get done and job X is completed.

The second technique handles problems like this: you know how to write the program but it has a lot of repetitive or trivial parts. So you write a different, shorter program, a *source program* which will make the computer write the program you really want, called the *object program.* If the source program has trivial parts also, you can extend the process several programs

Take the ultimate trip – into the UNGAME. To conceive the mischievous UNGAME let programs 1, 2 and 3 orgy in weird positions, explained in the text. The UNGAME, once born, will turn its knife into the gut of any snott-nosed kid.

program 1 — vocabulary

```
410  PRINT "0";
430  PRINT "1";
450  PRINT "2";
490  PRINT "3";
510  PRINT "4";
530  PRINT "5";
580  PRINT "6";
600  PRINT "7";
620  PRINT "8";
650  PRINT "9";
670  PRINT "K";
730  PRINT "=";
750  PRINT ">";
770  PRINT "+";
800  PRINT "-";
820  PRINT "*";
870  PRINT "/";
890  PRINT "↑";
910  PRINT ";";
940  PRINT ",";
960  PRINT "'";
1030  PRINT "(";
1050  PRINT ")";
1070  PRINT " ";
1120  PRINT "";
1170  PRINT " DATA ";
1190  PRINT " GOSUB ";
1210  PRINT " GOTO ";
1240  PRINT " IF ";
1260  PRINT " INT ";
1320  PRINT " LET ";
1340  PRINT " LOG ";
1360  PRINT " PRINT ";
1390  PRINT " READ ";
1410  PRINT " RESTOR ";
1460  PRINT " RETURN ";
1480  PRINT " STOP ";
1500  PRINT " TO ";
1530  PRINT "";
1550  PRINT " REM ";
```

program 2 — data

```
6010  DATA  31, 10, 11, 10, 13, 1, 0, 24
6020  DATA  33, 10, 18, 24
6030  DATA  34, 10, 1, 24
6040  DATA  29, 10, 1, 11, 2, 5, 28, 110, 24
6050  DATA  29, 10, 1, 12, 4, 0, 28, 90, 24
6060  DATA  27, 350, 24
6070  DATA  29, 10, 1, 11, 2, 4, 28, 23, 1, 0, 24
6080  DATA  28, 23, 3, 0, 24
6090  DATA  33, 10, 1, 18, 24
6100  DATA  28, 23, 3, 0, 24
6110  DATA  31, 10, 2, 11, 32, 21, 1, 0, 22, 24
6120  DATA  35, 24
6130  DATA  33, 24
6140  DATA  31, 10, 11, 10, 13, 1, 0, 24
6150  DATA  33, 10, 18, 24
6160  DATA  31, 10, 1, 11, 2, 6, 24
6170  DATA  27, 350, 24
6180  DATA  31, 10, 1, 11, 2, 3, 24
6190  DATA  27, 350, 24
6200  DATA  34, 10, 3, 24
6210  DATA  31, 10, 5, 11, 10, 3, 24
6220  DATA  31, 10, 4, 11, 30, 21, 32, 21, 10, 39
6230  DATA  3, 13, 1, 16, 2, 22, 16, 10, 2, 22, 24
6240  DATA  31, 10, 1, 11, 30, 21, 10, 39
6250  DATA  3, 16, 1, 0, 17, 10, 4, 22, 24
6260  DATA  27, 350, 24
6270  DATA  31, 10, 3, 11, 10, 3, 14, 10, 39
6280  DATA  1, 15, 1, 0, 17, 10, 4, 24
6290  DATA  31, 10, 4, 11, 10, 4, 14, 1, 24
6300  DATA  29, 10, 4, 12, 14, 1, 28, 230, 24
6310  DATA  29, 10, 5, 11, 3, 9, 28, 130, 24
6320  DATA  29, 10, 5, 11, 2, 4, 28, 130, 24
6330  DATA  29, 10, 5, 11, 2, 5, 28, 340, 24
6340  DATA  31, 10, 1, 11, 1, 9, 24
6350  DATA  27, 350, 24
6360  DATA  28, 180, 24
```

two techniques for increasing computer power

back: you do the typing for a few primitive seed programs which will transmute and metamorphose into the desired program.

The first technique is called *recursion.* It is a standard part of many high-level languages. It is illegal in BASIC. But BASIC can be tricked into doing it. That's what really counts.

The second technique is called *bootstrapping.* Other techniques in computer science are also called *bootstrapping.* The short program that loads a loading program is called a *bootstrap loader.* When you write a language in the language you're writing, that's bootstrapping. It's like the person who wants to get out of a hole but has no toehold. He reaches down, grabs his own bootstraps and tugs up mightily. And, in the worlds of six-dollar-bionic people or

program 3 — bootstrap

```
2  REM      BOOTSTRAP.  PROGRAM WRITTEN BY KEN JACKMAN
5  GOTO  1980
7  PRINT " 5 REM THIS PROGRAM WRITES THE SELF-REPLICATING PROGRAM"
10  LET K=K+10
20  PRINT K;
30  READ K1
40  IF K1=25 GOTO  2000
50  IF K1>50 GOTO  90
60  GOSUB  330
70  IF K1=24 GOTO  10
80  GOTO  30
90  PRINT K1;
100  GOTO  30
330  REM
1100  PRINT
1980  PRINT "2 REM SOURCE PROGRAM FOR SELF-REPLICATING PROGRAM"
1985  PRINT "5 REM ANTEPENULTIMATE PROGRAM VIA JACKMAN'S BOOTSTRAP"
1990  GOTO  2010
2000  PRINT
2010  LET M[ 0]= 0
2020  LET N[ 0]=40
2030  LET C[D]=350
2040  GOSUB  4020
2044  PRINT " 2041 GOTO 2050"
2046  PRINT " 4033 LET K1=M(D)"
2048  STOP
2050  LET K=C[ 0]-10
2070  LET P=1
2075  LET C[ 0]=1940
2080  LET M[ 0]= 0
2090  LET N[ 0]=40
2100  LET K2= LOG (10)
2140  PRINT " 6370  DATA 37, 24"
2150  GOSUB  4020
2160  STOP
4020  LET D= 0
4030  IF N[D]>M[D] GOTO  4100
4031  IF P=1 GOTO  4330
4032  IF M[D]=24 GOTO  4400
4033  GOTO  4040
4034  PRINT C[D];" REM PRINT '"";
4035  GOSUB  330
4036  PRINT "'";"
4040  PRINT C[D]+10;" RETURN"
4050  LET C[D]=C[D]+20
4060  LET D=D-1
4070  RETURN
4080  IF P=1 GOTO  4230
4085  PRINT C[D];" IF K1>";N[D];" GOTO ";C[D]+30*(N[D]-M[D]+1)
4090  LET C[D]=C[D]+10
4095  RETURN
4100  LET D=D+1
4110  LET C[D]=C[D-1]
4120  LET M[D]=M[D-1]
4130  LET N[D]= INT ((M[D-1]+N[D-1])/2)
4135  GOSUB  4080
4140  GOSUB  4030
4145  LET D=D+1
4150  LET M[D]= INT ((M[D-1]+N[D-1])/2)+1
4160  LET N[D]=N[D-1]
4170  GOSUB  4030
4180  LET C[D]=C[D+1]
4190  LET D=D-1
4200  IF D=-1 GOTO  4220
4210  LET C[D]=C[D+1]
4220  RETURN
4230  PRINT C[D]+4440;
4240  LET K1=26
4250  GOSUB  330
4260  PRINT " 29, 10, 1, 12, ";
4270  LET K3=N[D]
4272  LET K4= INT ( LOG (K3+1/2)/K2)
4273  LET K1= INT (K3/10↑K4)
4274  GOSUB  330
4275  LET K3=K3-K1*10↑K4
4276  LET K4=K4-1
4277  PRINT ", ";
4278  IF K4>-1 GOTO  4273
4280  PRINT "28,";
4290  LET K3=C[D]+30*(N[D]-M[D]+1)
4300  PRINT K3-1590;
4310  PRINT ", 24"
4320  GOTO  4090
4330  IF M[D]=24 GOTO  4500
4340  PRINT C[D]+4440;" DATA 40, 33, 20, 20, ";
4350  LET K3=M[D]
4360  IF K3=25 GOTO  4375
4362  LET K4= INT ( LOG (K3+1/2)/K2)
4363  LET K1= INT (K3/10↑K4)
4364  GOSUB  330
4365  LET K3=K3-K1*10↑K4
4366  LET K4=K4-1
4368  IF K4>-1 GOTO  4363
4370  PRINT ", ";
4375  PRINT "20, 20, 18, 24"
4380  PRINT C[D]+4450;" DATA 36, ";
4382  IF C[D]<3140 GOTO  4388
4384  PRINT "25"
4386  GOTO  4390
4388  PRINT "24"
4390  GOTO  4050
4400  PRINT C[D];
4410  PRINT " PRINT"
4440  GOTO  4040
4500  PRINT C[D]+4440;" DATA 33, 24"
4510  GOTO  4380
6370  DATA  37, 25
```

computers, he extricates himself from his predicament. Such behavior is quite acceptable in universes where Newton's third law doesn't apply.

We shall apply both techniques in writing the UNGAME program. First, we should consider "Usefulness" in general and the "Usefulness of the UNGAME" in particular.

At a recent meeting of the Homebrew Computer Club in the Stanford Linear Accelerator Auditorium, standing-room only, with over 300 computer enthusiasts representing more than 100 operating personal computing systems, one of the younger attendants rose before the group and announced that he would like some help to get his computer to do something *useful.* There was a spontaneous erruption of good-natured boos and hisses. What could provoke such widespread, instantaneous mock-antagonism from such a wholesome request?

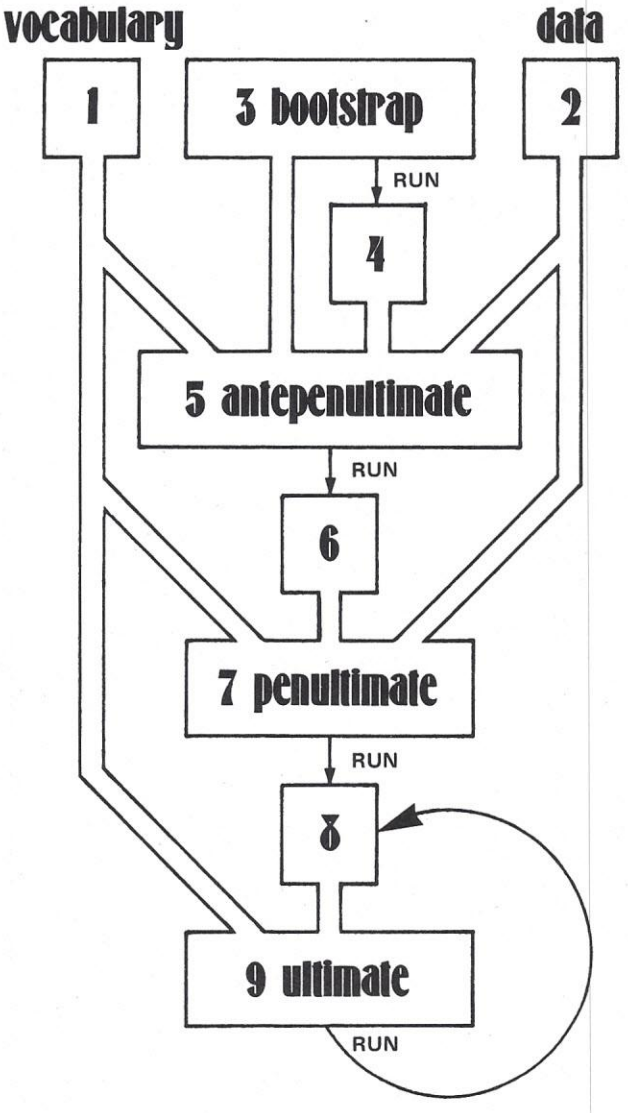
It's because we enthusiasts are beleaguered by the "usefulness" question. Everywhere we turn it pops up. "Why do you want to build that?" "What use is it?" "What will you do with it?" "Why write a program like that?" "But what is it good for?" If we had a good reply, it wouldn't be so bad. But, frankly, whatever it is, it is not useful. It's fun. If the questioner doesn't already see that, he never will. So we squeeze our brains to respond with a drop of usefulness for our pet. Then, the inevitable from our persecutor: "For such a measly drop of usefulness you shouldn't have expended such vast quantities of your time."

Now we have no cards left to play. We confess that we didn't really do it for that drop of usefulness. We did it for fun. Really. He mulls that one over a few milliseconds and says as he starts to walk away, "Oh, you did it for fun. Now that's useful. Very useful." He's humoring us now. He knows that we are rationalizing. We wasted all that time in excruciating agony for that pitiful drop of usefulness, and all we have left is to lie to ourselves. He knows the conversation is over, and he wants to exit as quickly as possible.

"But it was fun," we call out meekly at his departing figure. "It was fun. It was fun . . . ."

So much for usefulness. And on to the usefulness of the UNGAME. Originally the UNGAME was not the UNGAME, but was simply a program. In fact a useless program. Perhaps the greatest monument to uselessness of all time. But it all crumpled when confronted with the Usefulness Question. Here is how you use the UNGAME.

Do you know that snotty-nosed kid who thinks he knows everything but barely knows anything? (Someone like we were ourselves some untold decades ago.) His father bought him a computer kit which the kid promptly cleaned with steel wool and dribbled some solder on. But the computer didn't work right away even though most of the wires were connected pretty close to the right terminals. So Dad, president of his own company, took the thing to work for



Here's how to create the ultimate program.

From Innovation

Ken Jackman has pointed in this Ungame *article to an eternal conflict into which personal computers are pushed for the first time. The tension between the people who want to "do something useful" and those who want to play freely with their systems is the old struggle between the basic and applied researchers, those who are seeking new ideas and information and those who want to apply the new material to particular functions.*

PERSONAL COMPUTING *discussed the notion with the author (who hadn't really noticed that he had touched upon a classic subject) and agreed that it's an important matter. Amateurs are now able to do basic research with computers, if they choose, without waiting hat-in-hand for some institution to give them permission to play with the equipment. Are we in for an era of unprecedented innovation, of great leaps forward in knowledge? If so, how soon will the practical fruits of the intellectual exercise be available? Big questions. No simple answers.*

However, the subject isn't entirely new, and a superb general study is available for thinkers who want to pursue the matter. PERSONAL COMPUTING *asked Dr. Sam Globe of Battelle Columbus Laboratories (the man who ramroded the original study, we are told) to comment on his work and the opportunity for innovation in personal computing.*

Pleading ignorance of personal computing, Dr. Globe provided the crisp commentary that follows, sticking to his own area. Are you an innovator? Are you an entrepreneur hoping to profit in cash and excitement from the big action in personal computing? Listen to the man.

some final debugging. Three engineers and 12 technicians expended a mere 300 man-hours to make it work perfectly. Then the kid learned BASIC, and consequently, he knew everything there was to know about programming. To prove it, he wrote a program where you try to guess what number the computer is thinking of. Do you know that kid? Sure you do.

Give him a copy of the UNGAME. Don't tell him the name of the game. Tell him it's a really challenging game written in BASIC. Tell him it's self-explanatory.

He runs home and slaps it into the computer-that-he-built-all-by-himself and commands it to RUN. But, instead of RUNning, it LISTS sickly. (It's not supposed to LIST when he commands it to RUN.) Our instant genius is not thrown by this. The interpreter must have a bad bit. He reloads the interpreter and then the game. It still LISTs. Maybe the loader has a bad bit. He bootstraps in a new loader, loads the interpreter and then the game (again, again). And it still LISTs. Perhaps the Bootstrap loader is bad. He toggles in a new Bootstrap loader and etc. etc. etc. And the LIST persists. Eight hours after he first set his hot little hands on the UNGAME he concludes that his computer has a bad bit. And he sends Daddy to work with orders to find and eliminate that bad bit.

At this point I feel compelled to quote Jackman's Law for that rare individual who has not already memorized it. "If you try to repair something that isn't bad, it will be."

Anyway, Daddy brings home the computer-that-wasn't-really-bad-but-now-is and gives it back to Junior with the admonition that he will have to do some repairing of his own. And Junior does do a little repairing. He repairs to his basement, never to be seen again. Another victim of the UNGAME.

You may have guessed it by now. The UNGAME is a program whose output is a program. The program that it writes: its own self. Its output is its listing. Its only use, albeit *ex post facto:* zapping wet-nosed sophomaniacs.

In principle, a program that writes its own self is simple. It consists of three parts: A, B and C. Part C is entirely data, and the data corresponds exactly to the contents of A and B. Part A is a program that uses the data to write parts A and B. Part B is a program that uses the data to rewrite the data into data statements. That is, to copy part C. If you've got an interpreter that handles string data, you've got it made. My interpreter does not handle string data, so I have to supplement part A with a data-to-text converter. Also, my interpreter is incapable of PRINTing a double-quote. So where a double-quote is required, the program prints two single-quotes. Then in order to make the output a legal program, a REM is emitted ahead of PRINT statements. Before you attempt to RUN a program that is the output of my program, you must intervene manually and convert the REM

to Inventory

by Samuel Globe

How does a bright idea become a technological breakthrough? What is the role of research and development (R&D) in this process? What factors and circumstances influence such developments?

The succession of steps by which a new idea is transformed into a marketable product is known as technological innovation. Study of this process has generated a literature of its own.

A few years ago, the National Science Foundation sponsored a study,* at the Battelle Memorial Institute, of a number of innovations of high social or economic impact. The analysis, performed by a team of 17 specialists, ranged over 10 innovations from various fields of technology, including such developments as the heart pacemaker, hybrid corn, electrophotography and the video tape recorder.

While our conclusions were drawn from case studies and are not based on a statistically planned selection of cases, they gain credibility from being in accord with what others have found in similar studies.

Of special interest to the National Science Foundation was the role played by the categories of R&D commonly known as basic research, applied research and development. It should startle no one that among these three categories, the role of basic research was, on the average, greatest in the early phase of an innovation; that of applied research most important in the intermediate phase; and the role of development was most significant in the terminal phase. What is more interesting, perhaps, is that basic research made some contributions up to the very end and that there was some development going on at the very beginning.

In the study, we tried to define carefully when an innovation started and when it was completed. On the basis of these definitions the time from start to finish ranged from 6 years (for the video tape recorder) to 32 years (for the heart pacemaker), with an average of about 19.

Among the various circumstances found influential in promoting innovation, two merit brief comment. One was "Early Recognition of the Need," often described in the literature on innovation as "market pull." Market pull may be contrasted with "technology push," which often leads to a "solution looking for a problem." A second circumstance found to be influential was the presence of a "Technical Entrepreneur," who is often known as a "product champion." He is the promoter, whose doggedness and dedication through thick and thin often spell the difference between an aborted effort and a successful enterprise.

Apart from the quantitative and qualitative results of the analysis, the history of the cases often contain human-interest stories: a young genius and bootleged R&D (the video tape recorder); research in a virtual garrett and a near-failure in the search for support of a demonstrated revolutionary process (electrophotography, which led to the dramatic rise of the Xerox Corp.); attack by professional colleagues and in the law courts (the heart pacemaker).

But one thing remains unknown from both Battelle's study and other investigations of the innovative process: how to program innovation on demand. Maybe it's just as well.

Science, Technology, and Innovation available as PB228509/AS, $3.25 paper, $1.45 michrofiche; from the National Technical Information Service, Department of Commerce, Springfield, VA 22151

program 9 — ultimate

```
10  LET K=K+10
20  PRINT K;
30  READ K1
40  IF K1=25 GOTO  110
50  IF K1>40 GOTO  90
60  GOSUB  350
70  IF K1=24 GOTO  10
80  GOTO  30
90  PRINT K1;
100  GOTO  30
110  LET K2= LOG (10)
120  RESTOR
130  PRINT
140  LET K=K+10
150  PRINT K;
160  LET K1=26
170  GOSUB  350
180  LET K1=23
190  GOSUB  350
200  READ K3
210  LET K5=K3
220  LET K4= INT ( LOG (K3+1/2)/K2)
230  LET K1= INT (K3/10↑K4)
240  GOSUB  350
250  LET K3=K3-K1*10↑K4
260  LET K4=K4-1
270  IF K4>-1 GOTO  230
280  IF K5=39 GOTO  130
290  IF K5=24 GOTO  130
300  IF K5=25 GOTO  340
310  LET K1=19
320  GOSUB  350
330  GOTO  180
340  STOP
350  IF K1>20 GOTO  980
360  IF K1>10 GOTO  690
370  IF K1>5 GOTO  550
380  IF K1>2 GOTO  470
390  IF K1>1 GOTO  450
400  IF K1> 0 GOTO  430
410  PRINT "0";
420  RETURN
430  PRINT "1";
440  RETURN
450  PRINT "2";
460  RETURN
470  IF K1>4 GOTO  530
480  IF K1>3 GOTO  510
490  PRINT "3";
500  RETURN
510  PRINT "4";
520  RETURN
530  PRINT "5";
540  RETURN
550  IF K1>8 GOTO  640
560  IF K1>7 GOTO  620
570  IF K1>6 GOTO  600
580  PRINT "6";
590  RETURN
600  PRINT "7";
610  RETURN
620  PRINT "8";
630  RETURN
640  IF K1>9 GOTO  670
650  PRINT "9";
660  RETURN
670  PRINT "K";
680  RETURN
690  IF K1>15 GOTO  840
700  IF K1>13 GOTO  790
710  IF K1>12 GOTO  770
720  IF K1>11 GOTO  750
730  PRINT "=";
740  RETURN
750  PRINT ">";
760  RETURN
770  PRINT "+";
780  RETURN
790  IF K1>14 GOTO  820
800  PRINT "-";
810  RETURN
820  PRINT "*";
830  RETURN
840  IF K1>18 GOTO  930
850  IF K1>17 GOTO  910
860  IF K1>16 GOTO  890
870  PRINT "/";
880  RETURN
890  PRINT ":";
900  RETURN
910  PRINT ";";
920  RETURN
930  IF K1>19 GOTO  960
940  PRINT ",";
950  RETURN
960  PRINT "'";
970  RETURN
980  IF K1>30 GOTO  1280
990  IF K1>25 GOTO  1140
1000  IF K1>23 GOTO  1090
1010  IF K1>22 GOTO  1070
1020  IF K1>21 GOTO  1050
1030  PRINT "(";
1040  RETURN
1050  PRINT ")";
1060  RETURN
1070  PRINT " ";
1080  RETURN
1090  IF K1>24 GOTO  1120
1100  PRINT
1110  RETURN
1120  PRINT "";
1130  RETURN
1140  IF K1>28 GOTO  1230
1150  IF K1>27 GOTO  1210
1160  IF K1>26 GOTO  1190
1170  PRINT " DATA ";
1180  RETURN
1190  PRINT " GOSUB ";
1200  RETURN
1210  PRINT " GOTO ";
1220  RETURN
1230  IF K1>29 GOTO  1260
1240  PRINT " IF ";
1250  RETURN
1260  PRINT " INT ";
1270  RETURN
1280  IF K1>35 GOTO  1430
1290  IF K1>33 GOTO  1380
1300  IF K1>32 GOTO  1360
1310  IF K1>31 GOTO  1340
1320  PRINT " LET ";
1330  RETURN
1340  PRINT " LOG ";
1350  RETURN
1360  PRINT " PRINT ";
1370  RETURN
1380  IF K1>34 GOTO  1410
1390  PRINT " READ ";
1400  RETURN
1410  PRINT " RESTOR ";
1420  RETURN
1430  IF K1>38 GOTO  1520
1440  IF K1>37 GOTO  1500
1450  IF K1>36 GOTO  1480
1460  PRINT " RETURN ";
1470  RETURN
1480  PRINT " STOP ";
1490  RETURN
1500  PRINT " TO ";
1510  RETURN
1520  IF K1>39 GOTO  1550
1530  PRINT "";
1540  RETURN
1550  PRINT " REM ";
1560  RETURN
1570  DATA  31, 10, 11, 10, 13, 1, 0, 24
1580  DATA  33, 10, 18, 24
1590  DATA  34, 10, 1, 24
1600  DATA  29, 10, 1, 11, 2, 5, 28, 110, 24
1610  DATA  29, 10, 1, 12, 4, 0, 28, 90, 24
1620  DATA  27, 350, 24
1630  DATA  29, 10, 1, 11, 2, 4, 28, 23, 1, 0, 2
1640  DATA  28, 23, 3, 0, 24
1650  DATA  33, 10, 1, 18, 24
1660  DATA  28, 23, 3, 0, 24
1670  DATA  31, 10, 2, 11, 32, 21, 1, 0, 22, 24
1680  DATA  35, 24
1690  DATA  33, 24
1700  DATA  31, 10, 11, 10, 13, 1, 0, 24
1710  DATA  33, 10, 18, 24
1720  DATA  31, 10, 1, 11, 2, 6, 24
1730  DATA  27, 350, 24
1740  DATA  31, 10, 1, 11, 2, 3, 24
1750  DATA  27, 350, 24
1760  DATA  34, 10, 3, 24
1770  DATA  31, 10, 5, 11, 10, 3, 24
1780  DATA  31, 10, 4, 11, 30, 21, 32, 21, 10, 3
1790  DATA  3, 13, 1, 16, 2, 22, 16, 10, 2, 22,
1800  DATA  31, 10, 1, 11, 30, 21, 10, 39
1810  DATA  3, 16, 1, 0, 17, 10, 4, 22, 24
1820  DATA  27, 350, 24
1830  DATA  31, 10, 3, 11, 10, 3, 14, 10, 39
1840  DATA  1, 15, 1, 0, 17, 10, 4, 24
1850  DATA  31, 10, 4, 11, 10, 4, 14, 1, 24
1860  DATA  29, 10, 4, 12, 14, 1, 28, 230, 24
1870  DATA  29, 10, 5, 11, 3, 9, 28, 130, 24
1880  DATA  29, 10, 5, 11, 2, 4, 28, 130, 24
1890  DATA  29, 10, 5, 11, 2, 5, 28, 340, 24
1900  DATA  31, 10, 1, 11, 1, 9, 24
```

PRINT (Single-quote, Single-quote) statements into PRINT (Double-quote) statements. You may not understand all this immediately, but you will if you actually follow these instructions:

- Type the seed programs 1, 2 and 3. These are the only programs you will need to type manually. All other programs will be typed by the computer. Save programs 1 and 2 on external medium. RUN program 3 and save the output on external medium; that output is program 4.
- Overwrite program 3 with program 4. Then overwrite the result with programs 1 and 2, to get program 5, the antepenultimate program.
- RUN program 5 and save the output on external medium; that output is program 6.
- SCRATCH (or NEW) the programs in the interpreter. Load program 6 and overwrite with programs 1 and 2, to get program 7, the penultimate program.
- RUN program 7 and save the output on external medium; that output is program 8.
- SCRATCH (or NEW) the programs in the interpreter.
- Load program 8. Manually convert the REM PRINT statements to PRINT statements (we are in luck: overwriting with program 1 does the job perfectly). The result is program 9, the ultimate program, which writes its own self by the following process:
- RUN program 9 and save the output on external medium; that output is program 8; with manual corrections to the REM PRINT statements it will be program 9. Proceed to the beginning of the previous paragraph.

If we had one of those neat interpreters with PEEK-POKE instructions, we could eliminate the manual correc-

```
1910  DATA  27, 350, 24
1920  DATA  28, 180, 24
1930  DATA  37, 24
1940  DATA  29, 10, 1, 12, 2, 0, 28, 980, 24
1950  DATA  29, 10, 1, 12, 1, 0, 28, 690, 24
1960  DATA  29, 10, 1, 12, 5, 28, 550, 24
1970  DATA  29, 10, 1, 12, 2, 28, 470, 24
1980  DATA  29, 10, 1, 12, 1, 28, 450, 24
1990  DATA  29, 10, 1, 12, 0, 28, 430, 24
2000  DATA  40, 33, 20, 20, 0, 20, 20, 18, 24
2010  DATA  36, 24
2020  DATA  40, 33, 20, 20, 1, 20, 20, 18, 24
2030  DATA  36, 24
2040  DATA  40, 33, 20, 20, 2, 20, 20, 18, 24
2050  DATA  36, 24
2060  DATA  29, 10, 1, 12, 4, 28, 530, 24
2070  DATA  29, 10, 1, 12, 3, 28, 510, 24
2080  DATA  40, 33, 20, 20, 3, 20, 20, 18, 24
2090  DATA  36, 24
2100  DATA  40, 33, 20, 20, 4, 20, 20, 18, 24
2110  DATA  36, 24
2120  DATA  40, 33, 20, 20, 5, 20, 20, 18, 24
2130  DATA  36, 24
2140  DATA  29, 10, 1, 12, 8, 28, 640, 24
2150  DATA  29, 10, 1, 12, 7, 28, 620, 24
2160  DATA  29, 10, 1, 12, 6, 28, 600, 24
2170  DATA  40, 33, 20, 20, 6, 20, 20, 18, 24
2180  DATA  36, 24
2190  DATA  40, 33, 20, 20, 7, 20, 20, 18, 24
2200  DATA  36, 24
2210  DATA  40, 33, 20, 20, 8, 20, 20, 18, 24
2220  DATA  36, 24
2230  DATA  29, 10, 1, 12, 9, 28, 670, 24
2240  DATA  40, 33, 20, 20, 9, 20, 20, 18, 24
2250  DATA  36, 24
2260  DATA  40, 33, 20, 20, 10, 20, 20, 18, 24
2270  DATA  36, 24
2280  DATA  29, 10, 1, 12, 1, 5, 28, 840, 24
2290  DATA  29, 10, 1, 12, 1, 3, 28, 790, 24
2300  DATA  29, 10, 1, 12, 1, 2, 28, 770, 24
2310  DATA  29, 10, 1, 12, 1, 1, 28, 750, 24
2320  DATA  40, 33, 20, 20, 11, 20, 20, 18, 24
2330  DATA  36, 24
2340  DATA  40, 33, 20, 20, 12, 20, 20, 18, 24
2350  DATA  36, 24
2360  DATA  40, 33, 20, 20, 13, 20, 20, 18, 24
2370  DATA  36, 24
2380  DATA  29, 10, 1, 12, 1, 4, 28, 820, 24
2390  DATA  40, 33, 20, 20, 14, 20, 20, 18, 24
2400  DATA  36, 24
2410  DATA  40, 33, 20, 20, 15, 20, 20, 18, 24
2420  DATA  36, 24
2430  DATA  29, 10, 1, 12, 1, 8, 28, 930, 24
2440  DATA  29, 10, 1, 12, 1, 7, 28, 910, 24
2450  DATA  29, 10, 1, 12, 1, 6, 28, 890, 24
2460  DATA  40, 33, 20, 20, 16, 20, 20, 18, 24
2470  DATA  36, 24
2480  DATA  40, 33, 20, 20, 17, 20, 20, 18, 24
2490  DATA  36, 24
2500  DATA  40, 33, 20, 20, 18, 20, 20, 18, 24
2510  DATA  36, 24
2520  DATA  29, 10, 1, 12, 1, 9, 28, 960, 24
2530  DATA  40, 33, 20, 20, 19, 20, 20, 18, 24
2540  DATA  36, 24
2550  DATA  40, 33, 20, 20, 20, 20, 20, 18, 24
2560  DATA  36, 24
2570  DATA  29, 10, 1, 12, 3, 0, 28, 1280, 24
2580  DATA  29, 10, 1, 12, 2, 5, 28, 1140, 24
2590  DATA  29, 10, 1, 12, 2, 3, 28, 1090, 24
2600  DATA  29, 10, 1, 12, 2, 2, 28, 1070, 24
2610  DATA  29, 10, 1, 12, 2, 1, 28, 1050, 24
2620  DATA  40, 33, 20, 20, 21, 20, 20, 18, 24
2630  DATA  36, 24
2640  DATA  40, 33, 20, 20, 22, 20, 20, 18, 24
2650  DATA  36, 24
2660  DATA  40, 33, 20, 20, 23, 20, 20, 18, 24
2670  DATA  36, 24
2680  DATA  29, 10, 1, 12, 2, 4, 28, 1120, 24
2690  DATA  33, 24
2700  DATA  36, 24
2710  DATA  40, 33, 20, 20, 20, 20, 18, 24
2720  DATA  36, 24
2730  DATA  29, 10, 1, 12, 2, 8, 28, 1230, 24
2740  DATA  29, 10, 1, 12, 2, 7, 28, 1210, 24
2750  DATA  29, 10, 1, 12, 2, 6, 28, 1190, 24
2760  DATA  40, 33, 20, 20, 26, 20, 20, 18, 24
2770  DATA  36, 24
2780  DATA  40, 33, 20, 20, 27, 20, 20, 18, 24
2790  DATA  36, 24
2800  DATA  40, 33, 20, 20, 28, 20, 20, 18, 24
2810  DATA  36, 24
2820  DATA  29, 10, 1, 12, 2, 9, 28, 1260, 24
2830  DATA  40, 33, 20, 20, 29, 20, 20, 18, 24
2840  DATA  36, 24
2850  DATA  40, 33, 20, 20, 30, 20, 20, 18, 24
2860  DATA  36, 24
2870  DATA  29, 10, 1, 12, 3, 5, 28, 1430, 24
2880  DATA  29, 10, 1, 12, 3, 3, 28, 1380, 24
2890  DATA  29, 10, 1, 12, 3, 2, 28, 1360, 24
2900  DATA  29, 10, 1, 12, 3, 1, 28, 1340, 24
2910  DATA  40, 33, 20, 20, 31, 20, 20, 18, 24
2920  DATA  36, 24
2930  DATA  40, 33, 20, 20, 32, 20, 20, 18, 24
2940  DATA  36, 24
2950  DATA  40, 33, 20, 20, 33, 20, 20, 18, 24
2960  DATA  36, 24
2970  DATA  29, 10, 1, 12, 3, 4, 28, 1410, 24
2980  DATA  40, 33, 20, 20, 34, 20, 20, 18, 24
2990  DATA  36, 24
3000  DATA  40, 33, 20, 20, 35, 20, 20, 18, 24
3010  DATA  36, 24
3020  DATA  29, 10, 1, 12, 3, 8, 28, 1520, 24
3030  DATA  29, 10, 1, 12, 3, 7, 28, 1500, 24
3040  DATA  29, 10, 1, 12, 3, 6, 28, 1480, 24
3050  DATA  40, 33, 20, 20, 36, 20, 20, 18, 24
3060  DATA  36, 24
3070  DATA  40, 33, 20, 20, 37, 20, 20, 18, 24
3080  DATA  36, 24
3090  DATA  40, 33, 20, 20, 38, 20, 20, 18, 24
3100  DATA  36, 24
3110  DATA  29, 10, 1, 12, 3, 9, 28, 1550, 24
3120  DATA  40, 33, 20, 20, 39
3130  DATA  20, 20, 18, 24
3140  DATA  36, 24
3150  DATA  40, 33, 20, 20, 40, 20, 20, 18, 24
3160  DATA  36, 25
```

tions in the ultimate program. If we had a string-manipulating interpreter, we could write the ultimate program directly. But alas, we would not experience the joy of seeing a handful of seed programs bootstrap their way to ultimate grandiosity. Ah, the advantages of the inferior interpreter.

So much for bootstrapping. On to recursion.

In program 3, lines 4020-4510 constitute a subroutine. If the subroutine cannot accomplish its task directly, it splits the task into roughly equal parts (lines 4120-4130 and 4150-4160) and calls itself twice (lines 4140 and 4170) to complete the task. The task is to write a binary program to convert data (from value M to value N) into corresponding character strings. If P equals 1, the subroutine performs a different but similar task: it writes the data statements that correspond to the binary program.

A detailed exposition of the inner workings of the program would be too great an effort for too little gain. The only thing of great value that can be concisely said at this point is this: the variables used by the subroutine are dimensioned to keep track of the depth (D) of the recursion. Before the routine calls itself, it must increase the depth (lines 4100 and 4145). When it completes a task the depth must be reduced (lines 4060 and 4190). That dimensioning trick is what allows BASIC to be used recursively.

One final note. Notice how "dirty" program 3 is. Any line number not ending in zero is the result of debugging. But look at how clean the ultimate program is. If I may mix a metaphor, it's a case of "garbage-in/coming-out smelling like a rose."

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CIRCLE 27

LET'S IMPROVE BASIC

In the last issue, Russ Walter proposed five ways to improve BASIC:

• Handle the word "to" consistently in the FOR statement, LIST statement and substring notation • Indent to show the program's structure • Allow long variable names • Improve the PRINT statement's punctuation • Eliminate terms that serve no purpose. James Woodward sent us his reaction.

"Let's Improve BASIC"— A User's Reaction

by James L. Woodward

Each user of any computer language has his pet peeves about its structure. Russ Walter has voiced his in the January/February PERSONAL COMPUTING; in the process he suggests changes that amount to a new language. As he points out, BASIC has "always walked uphill," adopting only features that are compatible with the previous version. He asks us to give up the immense library of existing programs in order to "improve" the language. Let us examine his suggestions.

He objects to the use of the word TO in the FOR v = a TO b command, feeling that it is inconsistent with the use of a hyphen in the executive command LIST, and suggests replacing both with a colon. I assume that this leaves us with FOR v = a:b STEP 2 which seems clumsy. Perhaps Mr. Walter would suggest something like FOR v = a:b,c. Unfortunately this makes it harder to remember which is the terminator and which the step. Also, I suspect that many less than perfect typists find TO faster typing than : since : is upper case and not as often used. The inconsistency might better be resolved by using the form LIST ln TO ln in the executive, which does not require a language change and may be implemented as desired.

He would indent rather than use NEXT. This is very well but wasteful. If each loop is to be indented four spaces as shown, a triple-nested loop (hardly unusual) would be 12 spaces into the line; many displays used on personal computers allow only a 32 space line. Furthermore, the extra spaces would have to be carried in memory; many programs have a major loop for almost the entire program and would require four extra bytes for almost every line. I suggest that Mr. Walter teach his students to indent if they have trouble with loops, but remind them that extra spaces are costly in memory requirements.

Similar arguments can be made for indenting IF as proposes to handle conditional transfers to a distant part of the program such as:

```
100 IF a THEN 200
.
.
150 IF b THEN 999
.
.
190 GO TO 100
200 . . .
.
.
999 END
```

Perhaps:

```
100 IF not a
.       X
.       X
150     IF b
160         GO TO 999
170     IF NOT
.           X
.           X
190         GO TO 100
200 X
```

This seems clumsy and not an improvement. Further, I think Walter is chasing paper dragons; you can always word a condition in one of two ways. In testing for legal input, for example, assume that X should be non-negative:

```
100 INPUT X
110 IF X<0 THEN 850
120 use X
.
.
850 PRINT "PLEASE LAY OFF THE MINUS SIGN"
```

seems perfectly natural. Hamurabi uses exactly this form four times with a different message at 850. If Mr. Walter were to retain IF THEN for such needs, he could have his IF without THEN as well, allowing it as a superset of the usual BASIC instructions.

I agree that variable names are a problem; allowing longer ones at a particular computer does not get us away from BASIC. I wonder, though, if looking at the first two letters is wise. I can just see a beginner using CIRCUMFERENCE and later on CIRCUS. If we allow shortened operands we must teach the beginner a forbidden list, or he will have

variables like PRICE. Perhaps just allow one or two letter variables or letter numerals and leave the operands three or more letters.

I agree that RND ought to be a function that is equivalent to INT(a + 0.5), and the random function should be named RAN, but we can certainly do without a RouND function and live with RaNDom.

The PRINT statement is a problem; without PRINT USING, there is no way to please all of the people all of the time (I can supply a beautiful routine to print dollars and cents from $999,999.00 to $0.01, in straight columns, with commas inserted, without PRINT USING. It prints each digit individually as a string and although it's faster than a Teletype, you can see it working one character at a time on a video display.) Mr. Walter objects to seeing TODAY JOE SCORED-5 versus TODAY JOE SCORED 5 as the usual rule; however, the space before positive but not before negative convention allows:

```
MATH  5 versus   MATH 5
ENGL - 5         ENGL - 5
HIST  3          HIST 3
```

which a space before positive or negative would produce. PRINT USING is the solution to these conflicting requirements. If he wants to change the usage of commas, semicolons and colons, it's all right with me. But is it worth giving up that immense library? I think not.

He proposes the elimination of "useless junk." I am afraid I like LET and END. It is basic to computing to say LET a = a+1; without the LET, the beginner is confused by the "absurd" a = a+1. Further argument I cannot make, and must defer to Mr. Walter's greater experience at teaching the subject. If END were eliminated, I would continue to write:

```
999 REM END or 999 'END.
```

Has a friend never forgotten the last page of a listing; will PERSONAL COMPUTING never drop the last three lines in the composing room by mistake? I like to know I've got it all. On the other hand, the apostrophe convention is great; saves two bytes at least. Besides I could never REMember if it was REMinder of REMember or REMark or REMiniscence.

What would I like to see changed in BASIC for the personal computer? First and most important, PRINT USING is needed; full Fortran type Format specification would not be a bad idea.

Secondly, a compiler. When I first wandered into the local computer retailer, I typed out the following on the 8080 based system that was there:

```
100 LET N=0
110 FOR I= 1 TO 10000
120 LET N=N+1
130 NEXT I
140 PRINT N
999 END
```

Some instinct had me change line 110 before I ran it to:

```
110 FOR I=1 TO 1000
```

It took 32 seconds after the push of the Return key to run to 1000; for one accustomed to running to 50000 in a similar time on a compiler-based system, that seemed an age. Sure, an interpreter makes sense for little stuff and experiments, but when your kids start running games, they're going to be impatient with slow responses. If I advertise a BASIC compiler in a future PERSONAL COMPUTING, you'll know I stopped waiting and wrote my own.

Thirdly, let's allow different length variables. It makes little sense for a simple integer counter to be carried in more than one byte. By keeping the assumption that all variables are real, but allowing their definition as short integers, we should be able to save some execution time and memory; this would take some care, since clearly the definition would require some extra time and memory.

Fourth, optionally allow the compiler or interpreter to overwrite unneeded functions. It's awfully frustrating to write a game or business analysis package that's a little too big and know you've got trigonometric and logarithmic functions occupying space.

Fifth, let the executive handle tape and allow tape files at run time (this should be optionally overwritable). The executive should be able to find an OLD program on a specified tape; in a compiler based system this could be either source code or object code at the user's option. Being able to WRITE TAPE and READ TAPE at run time could go a long way toward cutting down memory restrictions.

Sixth, allow an optional form of subroutine that shares only those variables listed in the call list. The special printing subroutine mentioned above is a fairly complex routine that uses a number of variables; before the introduction of PRINT USING, we used it widely for neat output. Each use required a careful check to see that it did not use variables with the same names as the calling program. How easy it would have been to GOSUB(X) 800, and know that it didn't matter what internal variables were named.

BASIC users have progressed far beyond the original conception of the language as a teaching method. In business analysis and forecasting it is in routine use for programs running hundreds or even thousands of lines; its power has also been proven in university and, more recently, home use. In suggesting changes to the language, we must be careful to consider the adverse effects on running time and space of too many options and that each change makes more previously written programs unreadable in the new language.

OTHER REACTIONS

James Woodward was not the only programmer who reacted. Here are the original proposals, reactions from Leigh Jones and James Large, and Russ Walter's replies to all three programmers.

THE WORD "TO"

Proposal: Let "10:" mean "from 10 up", and let "10:25" mean "from 10 up to 25." Use the notation in the FOR statement (FOR I=10:25), the LIST statement (LIST 10:25) and to indicate substrings (A$[10:25]). Don't use TO or a dash.

Janes: BASIC is supposed to be easy to learn and people think "to." A colon would be a useless fuzz factor. Why not say LIST 100 TO 500 or A$[3 TO 7]? If we permit A$[3 TO 7] could we also permit A$[3 FOR 5] to pick up a 5 character substring?

Large: LIST 100 TO 500 is much less confusing than 100:500, because the latter looks like a ratio to me.
Reply: Okay, you guys, you win. Let's keep the word TO. Janes' 3 FOR 5 is nice, but since FOR already has another meaning let's say 3 TAKE 5 instead.
Revised Proposal: Allow the phrase 10 TO 25 in the FOR statement (FOR I = 10 TO 25), the LIST statement (LIST 10 TO 25) and to indicate substrings (A$[10 TO 25]). Also allow the phrase 10 UP, which means begin at 10 and keep going up.

As an extended option, 5 TAKE 3 means begin at 5 and take 3 numbers. For example, A$[5 TAKE 3] consists of the 5th, 6th and 7th characters of A$. FOR I = 5 TAKE 3 STEP –.1 means I = 5 then 4.9 then 4.8. LIST 5 TAKE 3 means begin at line 5 and list 3 lines; the lines might turn out to be 5, 7 and 20.

INDENTING

Proposal: To show the program's structure, indent. To repeat lines many times, indent them under the word FOR; don't say NEXT. To execute lines only if a certain condition holds, indent them under the word IF; don't say THEN. To execute lines only if the previous IF condition was false, indent them under the phrase IF NOT. Indent the body of a multi-line function definition; don't say FNEND.
Janes: I abhor the idea of using indentation to indicate the range of a FOR loop, because an error caused by failure to indent would be more difficult to find than a missing NEXT (or FOR). Basic is supposed to be easy: NEXT I is more emphatic and clearer than cessation of indentation.

For nested loops, how far would you indent for the inner loop? (Surely you don't expect the indentation to be regular?)

Yes, I agree, Basic sorely needs some kind of IF. . . THEN . . . ELSE structure and I would like to recommend

```
IF. . . THEN BEGIN
.
.
END
ELSE (or IF NOT) BEGIN
.
.
END
```

where BEGIN and END would be used to bracket a block of statements. Single statements would simply follow the THEN or ELSE.

Would IF X=0 THEN I=2*J ELSE I=I+1 be too complex for a single BASIC statement?
Large: Using NEXT and FNEND are easier than remembering not to indent. I am all in favor of changing the IF THEN statement, but your suggestion is not perfect. The PDP-11 gives these options:

```
IF A=B THEN 100 ELSE 200
IF A=B THEN statement ELSE statement
```

The lower one has all the advantages of yours. The upper one eliminates the need to say

```
IF A=B
    GO TO 50
```

if a line jump is required.

Reply: You didn't understand the proposal. I didn't mean the only way to indent is to hit the space bar four times. There are several other ways: to indent quickly, hit the space bar once; to indent beautifully, type a horizontal tab (by holding down the CONTROL key while you type an I); to indent lines 100 to 500 after you've already typed them, give the edit command INDENT 100 TO 500.

In the Hamurabi program, replacing each THEN by an indented GO TO and each NEXT by indentation would cost 160 bytes, not 500.

Woodward can code the example about "IF NOT A" more briefly, like this:

```
100 IF not a
.       .
.       .
150     IF b
160         STOP
.       .
.       .
190     GO TO 100
.   .
.   .
```

He doesn't need GO TO 999 or IF NOT or END.

In his example about "please lay off the minus sign," he forgot to show the GO TO and STOP. In traditional BASIC, he would have to code like this:

```
100 INPUT X
110 IF X<0 THEN 850
120 use X
.   .
.   .
840 STOP
850 PRINT "PLEASE LAY OFF THE MINUS SIGN. INPUT"
860 GO TO 100
999 END
```

The proposal makes the coding briefer, by eliminating THEN and STOP:

```
100 INPUT X
110 IF X<0
112     PRINT "PLEASE LAY OFF THE MINUS SIGN. INPUT"
114     GO TO 100
120 use X
.   .
.   .
```

Why Indent? Indentation helps you understand someone else's program, or a program you wrote several months ago, or a program you're trying to debug. Clearer than a flowchart, it shows you immediately where the loops are and which statements are done conditionally.

The founders of traditional BASIC, Kemeny and Kurtz, know indentation's importance. In the second edition of their *Basic Programming*, they indent all FOR NEXT loops. Programmers at Dartmouth College have been writing routines that indent your programs automatically.

Cobol, the most widely used computer language in the world, makes the programmer indent. Programmers in most other languages (PL/I, Algol, Pascal, etc.) almost always indent even though they don't have to. Indenting is a good habit.

Indenting a block helps most when the block contains between 2 and 50 lines. For blocks that are very long or very short, let's offer alternatives.

Addition to Proposal: As an extended option, let the programmer move a one-line block to the end of the previous line. Examples:

```
100 IF X<3, PRINT "LOVE"
110 IF NOT, PRINT "HATE"
120 FOR I = 1 TO 10, PRINT I↑2
```

So instead of making him write—

```
200 FOR I = 1 TO 10
210     FOR J = 1 TO 10
220         S=S+A(I,J)
```

let him write—

```
200 FOR I = 1 TO 10
210         FOR J = 1 TO 10, S=S+A(I,J)
```

which he can abbreviate further:

```
200 FOR I = 1 TO 10, FOR J = 1 TO 10, S=S+A(I,J)
```

As another extended option, let the programmer say—

```
199 INDENT
701 UNINDENT
```

instead of physically indenting lines 200 to 700.

Transition. For the next few decades, computers should still accept the words NEXT, THEN and FNEND to allow old programs to run. But instructors should tell the students to indent instead. The words NEXT, THEN and FNEND should be phased out gradually.

VARIABLES

Proposal: Let variable names and keywords be as long as the programmer likes. Make the computer examine only the first two characters, so that CIRCUMFERENCE is the same as CI, PRINT can be abbreviated PR and LOGARITHM can be abbreviated LO or LOG or spelled LOGGYRITTEM. Name the random function RANDOM (abbreviated RA) instead of BASIC's unspeakable RND. Since PR IN is supposed to print IN but PRI N is supposed to print N instead, we must tell the computer to notice spacing.

Janes: I would like to see longer variable names, but I'm not sure two characters will be enough, because the truncation would not distinguish between SQUARE and SQRT. I would prefer four characters instead of two. Is the allowance for long variable names so expensive in terms of memory usage? Perhaps this could be an option when you order your BASIC?

Large: One reason BASIC is well-suited to beginners is that it ignores spacing; Hewlett-Packard BASIC even corrects spacing errors. Nobody ever complains about single-letter variables; multiple-letter variables would be time-consuming.

Reply: Programmers who've used other languages complain about BASIC's short variables. Programmers who've used only BASIC don't complain, because they don't know what they're missing. In the days of radio, nobody complained about lacking TV.

To see why long variable names help, try to figure out what each variable in the Hamurabi program stands for. Why does the program begin with D1=0, P1=0, Z=0, P=95, S=2800, H=3000, E=H−S, Y=3, A=H/Y, I=5, Q=1 and D=0? If the author had used English words instead of one-letter variables, we could find out easily. BASIC programs like Hamurabi are undecipherable.

Woodward's comment about PRICE misses the mark: the computer can tell the difference between PRINT and PRICE because PRINT begins the line and doesn't precede the equal sign. The user does not have to memorize any list of forbidden words.

But his comment about CIRCUMFERENCE versus CIRCUS and Janes' about SQUARE versus SQRT strike at the proposal's weak spot: two letters are not enough. Fortran uses six; Cobol and PL/I use 30. Let's use six, so we can copy the large library of Fortran programs into BASIC easily. Thirty would be too expensive for personal computers.

Revised Proposal: Let variable names and keywords be as long as the programmer likes. Require the computer to examine only the first six characters. Name the random function RANDOM and the arctangent function ATAN. Since FOR I = A TO TOM is supposed to differ from FOR I = ATO TO M, we must tell the computer to notice spacing.

As an extended option, use ASIN and ACOS; for degrees instead of radians use SIND, COSD, TAND, ASIND, ACOSD and ATAND; for logarithms base 10 use LOGTEN; and for multiplying an argument by pi use PI.

PRINTING

Proposal: In a PRINT statement, give the programmer total control over spacing. Do not automatically print spaces before or after a string or number, not even if the number is positive. Let the programmer put a comma between items to indicate no space, a semicolon to indicate a single space and a colon to indicate a tab to the next 14-character zone.

Janes: It seems as if we can take baby steps (single space between strings) or giant steps (tab to the next 14-character zone; why 14?). Why not use spaces in the PRINT statement to concatenate strings, a comma for single space, semicolon for tab to the next 8-character zone and colon to tab to the next 14-character zone? Could the user be allowed to set the output tabs?

Large: The proposal is excellent.

Reply: Printing a number with proper precision and spacing might require up to 14 characters. That's why most versions of BASIC use 14-character zones.

Woodward and Janes are right: the PRINT statement needs more options, which the end of this article will describe.

Transition. For the next few decades, computers should still accept the old punctuation, if the program begins with the statement OLD PRINT.

ELIMINATING

Proposal: Eliminate END, LET, SGN, IDN, CON, TRN, REM and ON GO TO. Instead of REM, use an apostrophe to indicate that the remainder of the line is a comment. Avoid ON GO TO by using string arrays and powerful IF statements.

Janes: An END is not needed to mark the end of a program, but using END shouldn't do any harm.

The only problem I can see with the "apostrophe convention" is that some implementations of BASIC use the apostrophe as a "single quote" when you want to include the double quote in a string. Would a backslash do? If not, why

not use the PL/I convention of using a slash followed by an asterisk?

Large: I frequently need IDN and CON in games that use a grid. The ON GO TO statement saves me many other statements, sometimes pages, when I write programs that use complex logic.

Reply: The PDP-11, Altair and most other computers let you omit LET and END because both words are nuisances when you're trying to write programs quickly.

Most microcomputers omit CON and IDN, because few programmers use them. The proposal lets Large fake MAT A=CON by writing:

```
FOR I = 1 TO M, FOR J = 1 TO N, A(I,J)=1
```

He can fake MAT A=IDN by writing:

```
FOR I = 1 TO N, FOR J - 1 TO N, A(I,J)=0
FOR I = 1 TO N, A(I,I)=1
```

The end of this article will describe another alternative to ON GO TO.

Change in Proposal: Use an exclamation point instead of an apostrophe.

OTHER SUGGESTIONS

Janes: One of my pet irritations with BASIC is the requirement to number every line. If we could GOTO a label, the line numbers would be used solely for editing. This would allow us to store the program without the useless numbers and insert more than 10 (or 100?) statements between two existing statements without having to renumber. Statement numbers would be added when the program is read into memory for any reason. To distinguish labels from variables, use a prefixed (or suffixed?) @ sign: GOTO @PHASERS or GOSUB TRAVEL@.

Why not include some constants? #PI (3.14. . .), #E (2.718. . .), degrees per radian, radians per degree, liters per quart, nautical miles per kilometer? It would sure save a lot of time trying to find them in a book.

Large: A GOTO X statement would be useful, as well as the RENUMBER command found on Hewlett-Packard computers.

The most useful aspect of PDP-11 BASIC is that it did not differentiate between commands and statements. The computer could handle any statement without a line number as easily as it could deal with 10 LIST or 60 SAVE. I also believe that an improved BASIC would have the PDP-11's software for handling random-access files.

The hobbyist would prefer a high-powered BASIC to Fortran or Cobol because the latter languages do not offer the same possibilities for writing programs that simulate computers or play hovercraft. Before you influence anyone to improve BASIC please consider my suggestions; I would not like to see BASIC reserved for beginners.

Reply: Woodward is misleading: an interpreter is not necessarily worse than a compiler. If you will run the same program hundreds of times, or your program, like his, contains a loop that is repeated hundreds of times, use a compiler; but otherwise, an interpreter is quicker and also requires less memory.

Most computers having full BASIC use a "two-level interpreter," which is a compromise between an interpreter and a compiler and combines the advantages of both. It compiles the program from BASIC into "intermediate code" and then interprets the intermediate code.

Thanks for your many suggestions. Do you have any others?

NEW PROPOSALS

Proposal: For unusual printing, say AS and AT instead of PRINT USING and TAB.

Details: Suppose X is 69.7841. Saying PRINT X AS 2.3 will make the computer print X as 69.784, because the "2.3" means to print two characters then a decimal point then three characters. PRINT X AS 3.7 will print 69.7841000 preceded by a blank. PRINT X AS 1.3E3 will print 6.978E+01.

Suppose J is 47, K is −59, L is 847, and M is 697. Saying PRINT X AS 2, K AS 4, L AS 2, M will print J as 47, K as −59 preceded by a blank, L as ?? (since L can't be printed as 2) and M as normal, so altogether it will print 47 -59??697.

Saying PRINT "CAT" AS 2 will print CA. Saying PRINT "CAT" AS 4 will print CAT then a blank.

PRINT X AT 17 will tab over to the 17th column and print X beginning there.

As an optional extension, allow Cobol's formats, which help applications to business. Suppose X is −783.6. Saying PRINT X AS 4V2 will print four characters, then an omitted decimal point, then two characters, like this: −78360. Saying PRINT X AS 3.2CR will print the absolute value of X in the form 3.2 and then prints either CR (if X is negative) or two blanks (if X is positive), like this: 783.60CR..

PRINT X AS $5.2 tempts the computer to print a dollar sign and then the form 5.2, to give $ −783.60; but the dollar sign will float toward the right, past the space and the negative sign, to give −$783.60 preceded by a blank. PRINT X AS *5.2 tempts the computer to print an asterisk and then the form 5.2, to give * −783.60; but asterisks will replace all blanks, to give **−783.60.

Proposal: Replace ON GO TO by TEST. Here's an example:

```
10 PRINT "HOW MANY EYES DO YOU HAVE?"
20 INPUT EYECOUNT
30 TEST EYECOUNT
40 IF 0
50      PRINT "YOU'RE BLIND"
60 IF 1
70      PRINT "YOU HAVE AN EYEPATCH OR GLASS"
80 IF 2
90      PRINT "YOU'RE BORING"
100 IF 3
110     PRINT "IT MUST BE NICE TO HAVE A SPARE"
120 IF NOT
130     PRINT "YOU MUST BE WEIRD"
140 PRINT "NICE MEETING YOU"
```

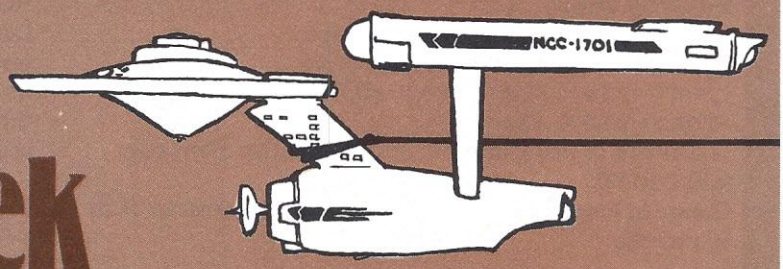
You can combine lines 40 and 50:

```
40 IF 0, PRINT "YOU'RE BLIND"
```

Lines 40 and 50 mean:

```
40 IF EYECOUNT=0
50      PRINT "YOU'RE BLIND"
59      GO TO 140
```

More Proposals will be in the next issue. Do you have any? How do you feel about the seven discussed so far?



A Startrek Walkthrough

Startrek games in many versions have been widely published, but the beginner is still hard-pressed to figure out out what the game is about. Steve Pollini offers a starter here, with some tips and techniques useful even to experienced players.

By Steve Pollini

"Bridge to Captain Kirk!"
"Kirk here."
"Sulu reporting, Sir. Three Klingon vessels in sectors 2-3, 4-6 and 5-7 attacking!"
"Red alert, man the battle stations, I'm on my way. Kirk out."

Startrek, the most popular computer game, is based on the television show. The game gives you a chance to save the galaxy from the evil Klingons.

Startrek is a strategy game in which you, a captain of the Enterprise, attempt to destroy the Klingon cruisers which threaten to obliterate the Federation. You are given a certain amount of time to accomplish your mission. If you fail, you will allow the Federation to be conquered by the remaining Klingon Cruisers; however, if you succeed... you will be immediately promoted to Admiral for saving the Federation. Your fate and that of the entire Federation are determined by your logic, ingenuity and (when Spock's not listening) your intuition.

The playing field for Startrek is a galaxy laid out in an eight quadrant by eight quadrant matrix. This gives a total of 64 quadrants in which Klingons, stars, star bases and the Enterprise reside. Each quadrant consists of 64 sectors, also arranged in an eight by eight matrix.

At the top of the next column is a Galactic Map which reveals the contents of all of the quadrants in the galaxy.

Cumulative Galactic Map for Stardate 3491

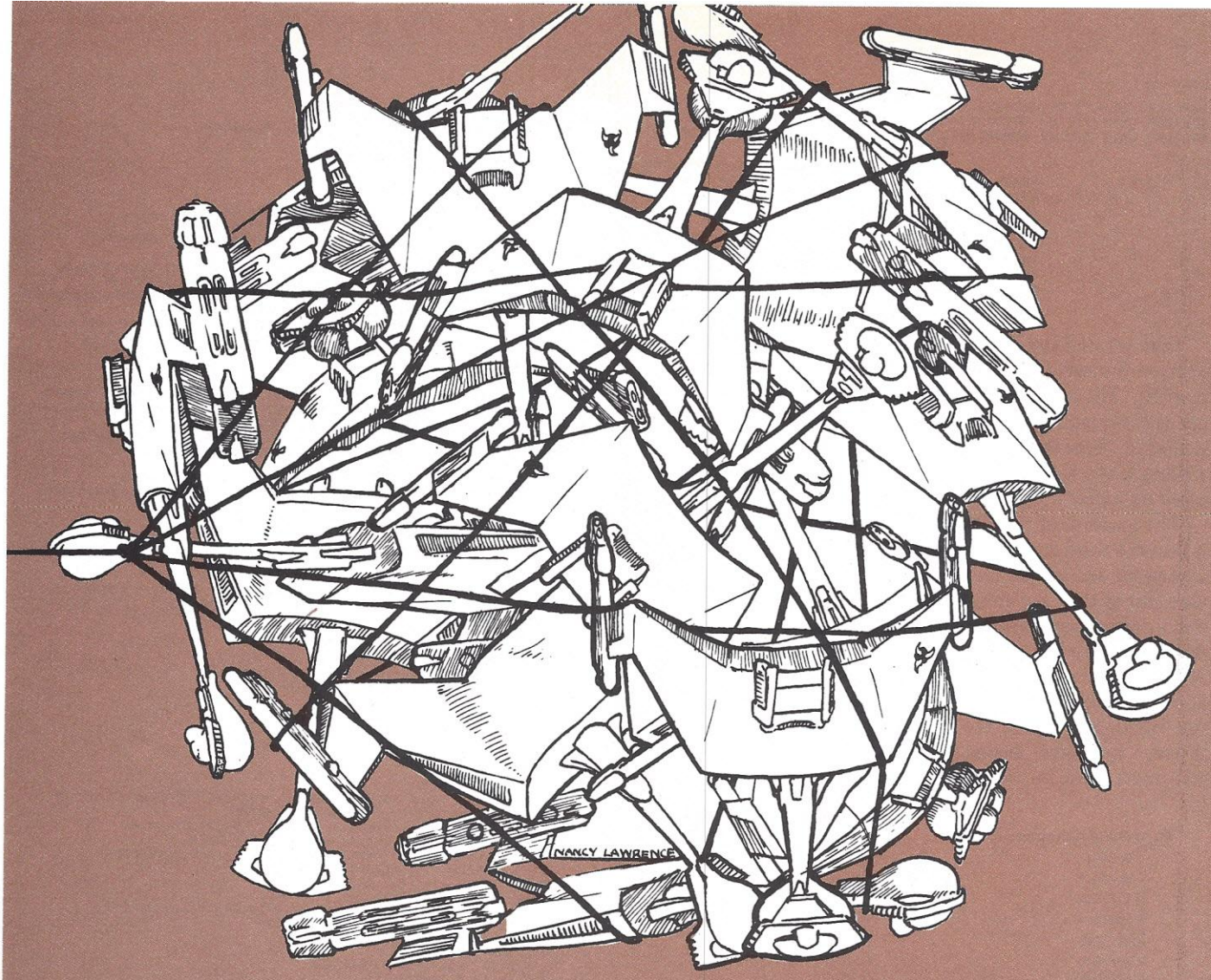
208	007	007	108	107	003	101	003
007	104	006	001	006	002	004	007
003	006	001	308	002	101	007	001
102	007	014	201	018	304	107	106
004	008	103	006	306	006	003	007
005	003	002	004	002	006	003	004
001	005	004	007	003	007	003	101
102	003	003	005	104	002	008	301

Each group of three numbers represents one quadrant. The first digit is the number of Klingon Cruisers, the second digit is the number of starbases and the third digit is the number of stars in the quadrant.

The chart below labels all of the quadrants in the galaxy. This is how the quadrant that you are in is labeled when you use your short- or long-range scanners. The sectors within each quadrant also use the same labeling convention.

1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8
2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8
3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8
4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8
5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8
6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8
7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8
8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8

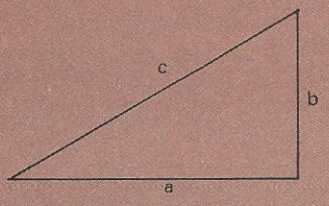
It takes a warp factor of one (1) to travel from one quadrant to another linearly, thus taking a warp 7 to travel the length of the galaxy. Fox example, to travel from quad-



rant 1-1 to 1-2 would take a warp 1. To travel from 1-2 to 1-7 would take a warp 5. The same holds for going up and down. Traveling from quadrant 1-7 to 8-7 takes a warp of 7.

Traveling diagonally is another story, however. If you were in quadrant 8-1, for example, and wanted to explore quadrant 5-4, it would be much more efficient to go directly to 5-4 rather than going via quadrants 5-1 or 8-4. To calculate the angular warp factor, count the number of quadrants you would need to go either left or right, then count the number necessary to travel up or down. In this example you would need to travel three quadrants to the right, from 8-1 to 8-4, and then go three quadrants up from 8-4 to 5-4. These two numbers are then squared and added and the square root of their sum is taken. The equation takes the following form:

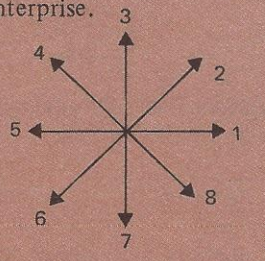
$$\text{Warp} = c = \sqrt{a^2 + b^2}$$



It's the simple Pythagorean formula for calculating the hypotenuse of a right triangle when the lengths of the two sides are known. The lengths of our two sides are 3 and 3, therefore:

$$\text{Warp} = \sqrt{3^2 + 3^2} = \sqrt{18} = 4.24$$

Therefore, to travel from quadrant 8-1 to quadrant 5-4 would take a warp of 4.24. Now you want to know how to guide your ship in the right direction. Read on, read on! Below is a diagram which shows the possible directions of travel for the Enterprise.



You choose a direction between 1 and 8.9 depending on where you want to go. Considering the above example, we would use a 2 to define our direction, since we want to travel up and to the right to get to quadrant 5-4.

Now you can warp your way all over the galaxy, but what do you do when you get where you're going to? Immediately upon arrival your computer will print out a short-range scan of the quadrant that you are presently occupying. It'll look something like this:

```
11/614 UNIT HIT ON ENTERPRISE FROM SECTOR 3-7  (4235.19 LEFT)
59.9889 UNIT HIT ON ENTERPRISE FROM SECTOR 6-8 (4175.2  LEFT)
46.7113 UNIT HIT ON ENTERPRISE FROM SECTOR 4-6 (4128.49 LEFT)


. . * . * . . .    YEARS = 524
. . . . . B * *    STARDATE = 3476
. . . * . . K .    CONDITION: RED
. . . . . K . .    QUADRANT = 5-4
. . . . . . . .    SECTOR = 8-3
. * . . . . * K    ENERGY = 4128.49
* . . . . . . .    PHOTON TORPEDOES = 10
. . E . . . . .    KLINGONS LEFT = 13
```

Here we find the Enterprise (E) confronted by three Klingon Cruisers (K). There's also a starbase in the second row (B). The sectors are labeled in precisely the same manner as the quadrants in the galactic map. Each sector point is labeled. Free space is a . (period), a star is an * (asterisk), a Klingon is a K, a starbase is a B, and the Enterprise is indicated by an E.

The location of the Klingon in the third row is 3-7, since it is in the third row and the seventh column. To travel among the sectors within the quadrant the warp engines are used just as they are in inter-quadrant travel. There is one major difference, however, and that is in the amount of warp needed to travel from sector to sector. Since it takes a warp of 1 to travel from one quadrant to the one beside or above it, and there are 8 sectors per quadrant, it then takes one-eighth or 0.125 of the warp to travel a sector distance as it does a quadrant. Below is a chart of linear (up-down or left-right) sector to sector warp factors.

To travel a distance of:	Use a warp of:
1 sector	0.125
2 sectors	0.250
3 sectors	0.375
4 sectors	0.500
5 sectors	0.625
6 sectors	0.750
7 sectors	0.875
8 sectors	1.000

Using a warp of 1.0 in a linear fashion will always put the Enterprise in an adjacent quadrant. This is not necessarily so, however, if the Enterprise is travelling diagonally. To travel diagonally, directions 2, 4, 6 or 8 will be used. The chart below lists the warps used to travel in one of these directions.

To travel a distance of:	Use a warp of:
1 sector	0.18
2 sectors	0.35
3 sectors	0.53
4 sectors	0.71
5 sectors	0.88
6 sectors	1.06
7 sectors	1.24
8 sectors	1.41

Remember, to calculate warps for angles other than 45° (directions 2, 4, 6 or 8) use the formula:

$$\text{Warp} = \sqrt{a^2 + b^2}$$

This holds for both quadrant to quadrant travel and sector to sector travel.

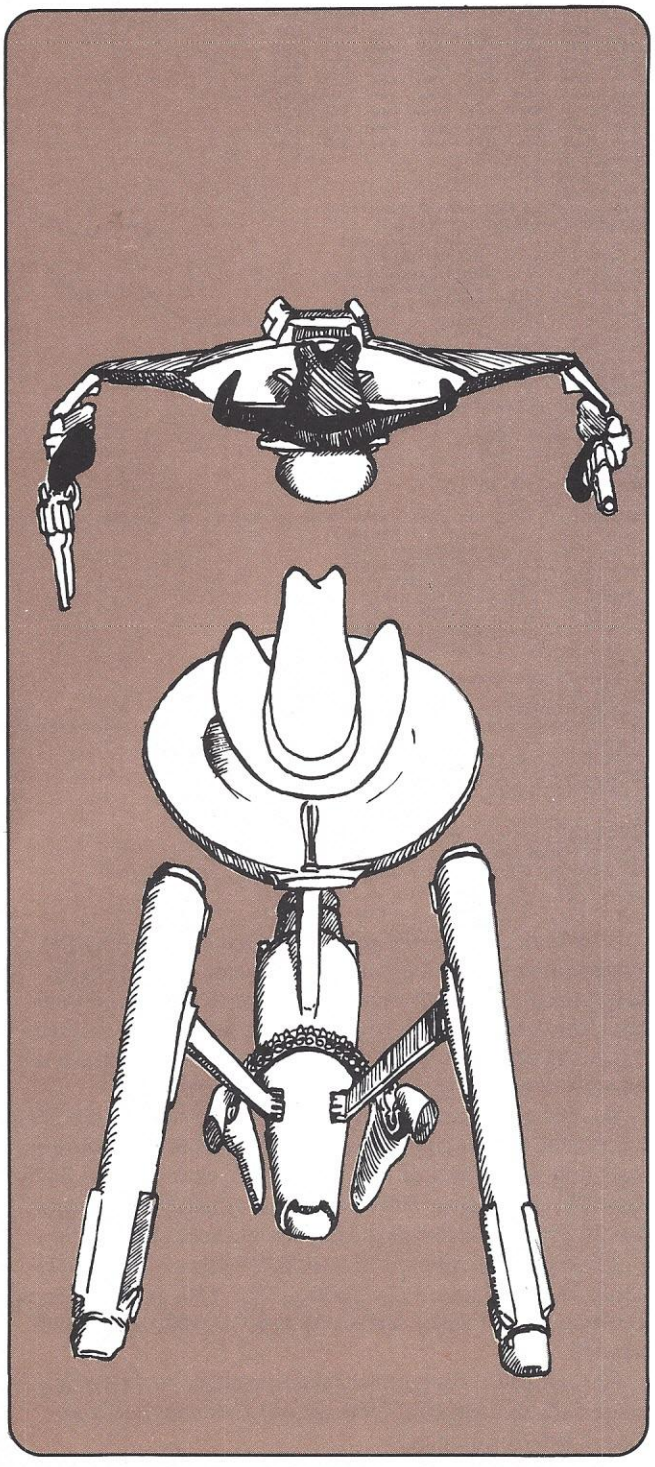
Below is a listing of the numbers that are used to effect each command.

1 = WARP ENGINES
2 = SHORT RANGE SENSORS
3 = LONG RANGE SENSORS
4 = PHASERS
5 = PHOTON TORPEDOES
6 = GALACTIC RECORDS

```
LIST

10 DIMD(5),K1(7),K2(7),K3(7),S(7,7),Q(7,7),D$(5)
20 Q$=".EKB*"
30 D$(0)="WARP ENGINES"
40 D$(1)="SHORT RANGE SENSORS"
50 D$(2)="LONG RANGE SENSORS"
60 D$(3)="PHASERS"
70 D$(4)="PHOTON TORPEDOES":D$(5)="GALACTIC RECORDS"
80 INPUT"PLEASE ENTER A RANDOM NUMBER";E$:I=ASC(E$)
90 I=I-11*INT(I/11):FOR J=0 TO I:K=RND(1):NEXT:PRINT"WORKING-"
100 DEF FND(N)=SQR((K1(I)-S1)↑2+(K2(I)-S2)↑2)
110 GOSUB 610:GOSUB 450:Q1=X:Q2=Y:X=8:Y=1:X1=.2075:Y1=6.28:X2=3.28
120 Y2=1.8:A=.96:C=100:W=10:K9=0:B9=0:S9=400:T9=3575:GOTO 140
130 K=K+(N<X2)+(N<Y2)+(N<.28)+(N<.08)+(N<.03)+(N<.01):K9=K9-K:GOTO 160
140 T0=3475:T=T0:E0=5000:E=E0:P0=10:P=P0:FORI=0TO7
150 FOR J=0 TO 7:K=0:N=RND(Y):IF N<X1 THEN N=N*64:K=(N<Y1)-Y:GOTO 130
160 B=(RND(Y)>A):B9=B9-B:Q(I,J)=K*C+B*W-INT(RND(Y)*X+Y):NEXT J,I
170 IF K9>(T9-T0) THEN T9=T0+K9
180 IF B9>0 THEN 200
190 GOSUB 450:Q(X,Y)=Q(X,Y)-10:B9=1
200 PRINT LEFT$("STARTREK ADAPTED BY L.E. COCHRAN 2/29/76",8):K0=K9
210 PRINT"OBJECTIVE: DESTROY";K9;"KLINGON BATTLE CRUISERS IN";T9-T0;
220 PRINT"YEARS.":PRINT" THE NUMBER OF STARBASES IS";B9
230 A=0:IF Q1<0 OR Q1>7 OR Q2<0 OR Q2>7 THEN N=0:S=0:K=0:GOTO 250
240 N=ABS(Q(Q1,Q2)):Q(Q1,Q2)=N:S=N-INT(N/10)*10:K=INT(N/100)
250 B=INT(N/10-K*10):GOSUB 450:S1=X:S2=Y
260 FOR I=0 TO 7:FOR J=0 TO 7:S(I,J)=1:NEXT J,I:S(S1,S2)=2
270 FOR I=0 TO 7:K3(I)=0:X=8:IF I<K THEN GOSUB 460:S(X,Y)=3:K3(I)=S9
280 K1(I)=X:K2(I)=Y:NEXT:I=S
290 IF B>0 THEN GOSUB 460:S(X,Y)=4
300 IF I>0 THEN GOSUB 460:S(X,Y)=5:I=I-1:GOTO 300
310 GOSUB 550:IF A=0 THEN GOSUB 480
320 IF E<=0 THEN 1370
330 I=1:IF D(I)>0 THEN 620
340 FOR I=0 TO 7:FOR J=0 TO 7:PRINT MID$(Q$,S(I,J),1);" ";:NEXT J
350 PRINT"  ";:ON I GOTO 380,390,400,410,420,430,440
360 PRINT"YEARS =";T9-T
370 NEXT:GOTO 650
380 PRINT"STARDATE=";T:GOTO 370
390 PRINT"CONDITION: ";C$:GOTO 370
400 PRINT"QUADRANT=";Q1+1;"-";Q2+1:GOTO 370
410 PRINT"SECTOR =";S1+1;"-";S2+1:GOTO 370
420 PRINT"ENERGY=";E:GOTO 370
430 PRINT D$(4);"=";P:GOTO 370
440 PRINT"KLINGONS LEFT=";K9:GOTO 370
450 X=INT(RND(1)*8):Y=INT(RND(1)*8):RETURN
460 GOSUB 450:IF S(X,Y)>1 THEN 460
470 RETURN
480 IF K<1 THEN RETURN
490 IF C$="DOCKED" THEN PRINT"STARBASE PROTECTS ENTERPRISE":RETURN
500 FOR I=0 TO 7:IF K3(I)<=0 THEN NEXT:RETURN
510 H=K3(I)*.4*RND(1):K3(I)=K3(I)-H:H=H/(FND(0)↑.4):E=E-H
520 E$="ENTERPRISE FROM":N=E:GOSUB 530:NEXT:RETURN
530 PRINT H;"UNIT HIT ON ";E$;" SECTOR";K1(I)+1;"-";K2(I)+1;
540 PRINT" (";N;"LEFT)":RETURN
550 FOR I=S1-1 TO S1+1:FOR J=S2-1 TO S2+1
560 IF I<0 OR I>7 OR J<0 OR J>7 THEN 580
570 IF S(I,J)=4 THEN C$="DOCKED":E=E0:P=P0:GOSUB 610:RETURN
580 NEXT J,I:IF K>0 THEN C$="RED":RETURN
590 IF E<E0*.1 THEN C$="YELLOW":RETURN
600 C$="GREEN":RETURN
610 FOR N=0 TO 5:D(N)=0:NEXT:RETURN
620 PRINT D$(I);" DAMAGED.";
630 PRINT" ";D(I);"YEARS ESTIMATED FOR REPAIR.":PRINT
640 IF A=1 THEN RETURN
650 INPUT"COMMAND";A
660 IF A<1 OR A>6 THEN 680
670 ON A GOTO 710,310,1250,1140,690,1300
680 FOR I=0 TO 5:PRINT I+1;"= ";D$(I):NEXT:GOTO 650
690 IF D(4)>0 THEN PRINT"SPACE CRUD BLOCKING TUBES.";:I=4:GOTO 630
700 N=15:IF P<1 THEN PRINT"NO TORPEDOES LEFT":GOTO 650
710 IF A=5 THEN PRINT"TORPEDO ";
720 INPUT"COURSE (1-8.9)";C:IF C<1 THEN 650
730 IF C>=9 THEN 710
740 IF A=5 THEN P=P-1:PRINT"TRACK:";:GOTO 900
750 INPUT"WARP (0-12)";W:IF W<=0 OR W>12 THEN 710
760 IF W<=.2 OR D(0)<=0 THEN 780
770 I=0:PRINT D$(I);" DAMAGED, MAX IS .2 ";:GOSUB 630:GOTO 750
780 GOSUB 480:IF E<=0 THEN 1370
790 IF RND(1)>.25 THEN 870
800 X=INT(RND(1)*6):IF RND(1)>.5 THEN 830
810 D(X)=D(X)+INT(6-RND(1)*5):PRINT"**SPACE STORM, ";
820 PRINT D$(X);" DAMAGED**":I=X:GOSUB 630:D(X)=D(X)+1:GOTO 870
830 FOR I=X TO 5:IF D(I)>0 THEN 860
840 NEXT
850 FOR I=0 TO X:IF D(I)<=0 THEN NEXT:GOTO 870
860 D(I)=.5:PRINT"**SPOCK USED A NEW REPAIR TECHNIQUE**"
870 FOR I=0 TO 5:IF D(I)=0 THEN 890
880 D(I)=D(I)-1:IF D(I)<=0 THEN D(I)=0:PRINT D$(I);" ARE FIXED!"
890 NEXT:N=INT(W*8):E=E-N-N+.5:T=T+1:S(S1,S2)=1
900 Y1=S1+.5:X1=S2+.5:IF T>T9 THEN 1370
910 Y=(C-1)*.785398:X=COS(Y):Y=-SIN(Y)
920 FOR I=1 TO N:Y1=Y1+Y:X1=X1+X:Y2=INT(Y1):X2=INT(X1)
930 IF X2<0 OR X2>7 OR Y2<0 OR Y2>7 THEN 1110
940 IF A=5 THEN PRINT Y2+1;"-";X2+1,
950 IF S(Y2,X2)=1 THEN NEXT:GOTO 1060
960 PRINT:IF A=1 THEN PRINT"BLOCKED BY ";
970 ON S(Y2,X2)-3 GOTO 1040,1020
980 PRINT"KLINGON";:IF A=1 THEN 1050
990 FOR I=0 TO 7:IF Y2<>K1(I) THEN 1010
1000 IF X2=K2(I) THEN K3(I)=0
1010 NEXT:K=K-1:K9=K9-1:GOTO 1070
1020 PRINT"STAR";:IF A=5 THEN S=S-1:GOTO 1070
1030 GOTO 1050:2L29E76C
1040 PRINT"STARBASE";:IF A=5 THEN B=2:GOTO 1070
1050 PRINT" AT SECTOR";Y2+1;"-";X2+1:Y2=INT(Y1-Y):X2=INT(X1-X)
1060 S1=Y2:S2=X2:S(S1,S2)=2:A=2:GOTO 310
1070 PRINT" DESTROYED!";:IF B=2 THEN B=0:PRINT". . .GOOD WORK!";
1080 PRINT:S(Y2,X2)=1:Q(Q1,Q2)=K*100+B*10+S:IF K9<1 THEN 1400
1090 GOSUB 480:IF E<=0 THEN 1370
1100 GOSUB 550:GOTO 650
1110 IF A=5 THEN PRINT"MISSED!":GOTO 1090
1120 Q1=INT(Q1+W*Y+(S1+.5)/8):Q2=INT(Q2+W*X+(S2+.5)/8)
1130 Q1=Q1-(Q1<0)+(Q1>7):Q2=Q2-(Q2<0)+(Q2>7):GOTO 230
1140 I=3:IF D(I)>0 THEN 620
1150 INPUT"PHASERS READY: ENERGY UNITS TO FIRE";X:IF X<=0 THEN 650
1160 IF X>E THEN PRINT"ONLY GOT";E:GOTO 1150
1170 E=E-X:Y=K:FOR I=0 TO 7:IF K3(I)<=0 THEN 1230
```

```
1180 H=X/(Y*(FND(0)↑.4)):K3(I)=K3(I)-H
1190 E$="KLINGON AT":N=K3(I):GOSUB 530
1200 IF K3(I)>0 THEN 1230
1210 PRINT"**KLINGON DESTROYED**"
1220 K=K-1:K9=K9-1:S(K1(I),K2(I))=1:Q(Q1,Q2)=Q(Q1,Q2)-100
1230 NEXT:IF K9<1 THEN 1400
1240 GOTO 1090
1250 I=2:IF D(I)>0 THEN 620
1260 PRINT D$(I);" FOR QUADRANT";Q1+1;"-";Q2+1
1270 FOR I=Q1-1 TO Q1+1:FOR J=Q2-1 TO Q2+1:PRINT"   ";
1280 IF I<0 OR I>7 OR J<0 OR J>7 THEN PRINT"***";:GOTO 1350
1290 Q(I,J)=ABS(Q(I,J)):GOTO 1340
1300 I=5:IF D(I)>0 THEN 620
1310 PRINT"CUMULATIVE GALACTIC MAP FOR STARDATE";T
1320 FOR I=0 TO 7:FOR J=0 TO 7:PRINT"  ";
1330 IF Q(I,J)<0 THEN PRINT"***";:GOTO 1350
1340 E$=STR$(Q(I,J)):E$="00"+MID$(E$,2):PRINT RIGHT$(E$,3);
1350 NEXT J:PRINT:NEXT I:GOTO 650
1360 PRINT:PRINT"IT IS STARDATE";T:RETURN
1370 GOSUB 1360:PRINT"THANKS TO YOUR BUNGLING, THE FEDERATION WILL BE"
1380 PRINT"CONQUERED BY THE REMAINING";K9;"KLINGON CRUISERS!"
1390 PRINT"YOU ARE DEMOTED TO CABIN BOY!":GOTO 1430
1400 GOSUB 1360:PRINT"THE FEDERATION HAS BEEN SAVED!"
1410 PRINT"YOU ARE PROMOTED TO ADMIRAL":PRINT K0;"KLINGONS IN";
1420 PRINT T-T0;"YEARS.  RATING=";INT(K0/(T-T0)*1000)
1430 INPUT"TRY AGAIN";E$:IF LEFT$(E$,1)="Y" THEN 110
```



```
RUN
PLEASE ENTER A RANDOM NUMBER? 654346
WORKING-
STARTREK
OBJECTIVE: DESTROY 17 KLINGON BATTLE CRUISERS IN 100 YEARS.
 THE NUMBER OF STARBASES IS 6
 37.49 UNIT HIT ON ENTERPRISE FROM SECTOR 3 - 1  ( 4962.51 LEFT)
 97.3635 UNIT HIT ON ENTERPRISE FROM SECTOR 1 - 8  ( 4865.15 LEFT)
. . . . . K   YEARS = 100
. . . . . .   STARDATE= 3475
K . . . . . *  CONDITION: RED
. . . . . E .  QUADRANT= 5 - 8
. . . . . .   SECTOR = 4 - 7
. * . . . . .  ENERGY= 4865.15
. * . . . . .  PHOTON TORPEDOES= 10
. . . . * . .  KLINGONS LEFT= 17
COMMAND? 5
TORPEDO COURSE (1-8.9)? 2.75
TRACK: 3 - 7   2 - 7         1 - 8
KLINGON DESTROYED!
 27.3942 UNIT HIT ON ENTERPRISE FROM SECTOR 3 - 1  ( 4837.75 LEFT)
COMMAND? 5
TORPEDO COURSE (1-8.9)? 4.85
TRACK: 4 - 6   4 - 5         4 - 4         4 - 3         3 - 2
 3 - 1
KLINGON DESTROYED!
COMMAND? 3
LONG RANGE SENSORS FOR QUADRANT 5 - 8
   008   006   ***
   005   004   ***
   006   015   ***
COMMAND? 1
COURSE (1-8.9)? 3
WARP (0-12)? 3
. . . . . .   YEARS = 99.0003
. . . . . .   STARDATE= 3476
. . . . . .   CONDITION: GREEN
. . . . . E   QUADRANT= 2 - 8
. . . . . .   SECTOR = 4 - 8
. . . . . .   ENERGY= 4790.25
. . . . . *   PHOTON TORPEDOES= 8
. . . . . .   KLINGONS LEFT= 15
COMMAND? 3
LONG RANGE SENSORS FOR QUADRANT 2 - 8
   012   005   ***
   003   001   ***
   001   003   ***
COMMAND? 1
COURSE (1-8.9)? 5
WARP (0-12)? 3
 66.3429 UNIT HIT ON ENTERPRISE FROM SECTOR 6 - 8  ( 4676.41 LEFT)
 26.7448 UNIT HIT ON ENTERPRISE FROM SECTOR 8 - 3  ( 4649.67 LEFT)
. . . . . E . .   YEARS = 98.0003
. . . . . .   STARDATE= 3477
* . . . . . .  CONDITION: RED
. . . . . .   QUADRANT= 2 - 5
. . . * . . * .  SECTOR = 1 - 6
. . . . . . K   ENERGY= 4649.67
. . . . * . . *  PHOTON TORPEDOES= 8
. . K . . . . .  KLINGONS LEFT= 15
COMMAND? 4
PHASERS READY: ENERGY UNITS TO FIRE? 600
 152.982 UNIT HIT ON KLINGON AT SECTOR 6 - 8  ( 116.919 LEFT)
 133.179 UNIT HIT ON KLINGON AT SECTOR 8 - 3  ( 206.576 LEFT)
 18.8652 UNIT HIT ON ENTERPRISE FROM SECTOR 6 - 8  ( 4030.8 LEFT)
 27.7105 UNIT HIT ON ENTERPRISE FROM SECTOR 8 - 3  ( 4003.09 LEFT)
COMMAND? 4
PHASERS READY: ENERGY UNITS TO FIRE? 600
 152.982 UNIT HIT ON KLINGON AT SECTOR 6 - 8  (-73.0588 LEFT)
**KLINGON DESTROYED**
 133.179 UNIT HIT ON KLINGON AT SECTOR 8 - 3  ( 10.9756 LEFT)
 .24313 UNIT HIT ON ENTERPRISE FROM SECTOR 8 - 3  ( 3402.85 LEFT)
COMMAND? 4
PHASERS READY: ENERGY UNITS TO FIRE? 60
 26.6356 UNIT HIT ON KLINGON AT SECTOR 8 - 3  (-16.2078 LEFT)
**KLINGON DESTROYED**
COMMAND? 3
LONG RANGE SENSORS FOR QUADRANT 2 - 5
   002   004   004
   006   005   008
   002   003   002
COMMAND? 1
COURSE (1-8.9)? 5
WARP (0-12)? 3
**SPACE STORM, GALACTIC RECORDS DAMAGED**
  1 YEARS ESTIMATED FOR REPAIR.

. . * . . . . .   YEARS = 97.0003
. . . . . .   STARDATE= 3478
. . . . . .   CONDITION: GREEN
. . . . . .   QUADRANT= 2 - 2
. . . . . .   SECTOR = 7 - 5
. . . . . .   ENERGY= 3295.35
. . . . E . . .  PHOTON TORPEDOES= 8
. . . . . .   KLINGONS LEFT= 13
COMMAND? 3
LONG RANGE SENSORS FOR QUADRANT 2 - 2
   001   016   103
   005   001   012
   206   006   001
COMMAND? 1
COURSE (1-8.9)? 2
WARP (0-12)? 1.4
**SPACE STORM, LONG RANGE SENSORS DAMAGED**
  2 YEARS ESTIMATED FOR REPAIR.

GALACTIC RECORDS ARE FIXED!
 102.414 UNIT HIT ON ENTERPRISE FROM SECTOR 6 - 2  ( 3171.43 LEFT)
. . . . . .   YEARS = 96.0003
. . . . . .   STARDATE= 3479
. . . . . *   CONDITION: RED
. . . . . .   QUADRANT= 1 - 3
. . E . . . .  SECTOR = 5 - 3
. K . . . . .  ENERGY= 3171.43
. * . * . . .  PHOTON TORPEDOES= 8
. . . . . .   KLINGONS LEFT= 13
COMMAND? 5
TORPEDO COURSE (1-8.9)? 6
TRACK: 6 - 2
```

(Continued on p. 130)

```
KLINGON DESTROYED!
COMMAND? 1
COURSE (1-8.9)? 6
WARP (0-12)? 2.8
 3.06939 UNIT HIT ON ENTERPRISE FROM SECTOR 7 - 3  ( 3124.86 LEFT)
 70.296 UNIT HIT ON ENTERPRISE FROM SECTOR 6 - 4  ( 3054.57 LEFT)
. . . . . .    YEARS = 95.0003
. . . . . .    STARDATE= 3480
. . * . . . .  CONDITION: RED
E . . * . . .  QUADRANT= 3 - 1
. . . . . * .  SECTOR = 4 - 1
. * . K . . .  ENERGY= 3054.57
. . K . * . *  PHOTON TORPEDOES= 7
. . . . . .    KLINGONS LEFT= 12
COMMAND? 4
PHASERS READY: ENERGY UNITS TO FIRE? 400
 119.741 UNIT HIT ON KLINGON AT SECTOR 7 - 3  ( 275.133 LEFT)
 119.741 UNIT HIT ON KLINGON AT SECTOR 6 - 4  ( 162.846 LEFT)
 20.5959 UNIT HIT ON ENTERPRISE FROM SECTOR 7 - 3  ( 2633.97 LEFT)
 9.23897 UNIT HIT ON ENTERPRISE FROM SECTOR 6 - 4  ( 2624.73 LEFT)
COMMAND? 4
PHASERS READY: ENERGY UNITS TO FIRE? 900
 269.416 UNIT HIT ON KLINGON AT SECTOR 7 - 3  (-28.6844 LEFT)
**KLINGON DESTROYED**
 269.416 UNIT HIT ON KLINGON AT SECTOR 6 - 4  (-122.002 LEFT)
**KLINGON DESTROYED**
COMMAND? 3
LONG RANGE SENSORS DAMAGED.  1 YEARS ESTIMATED FOR REPAIR.

COMMAND? 6
CUMULATIVE GALACTIC MAP FOR STARDATE 3480
  001  016  003  002  004  004  012  005
  005  001  012  006  005  008  003  001
  006  006  001  002  003  002  001  003
  ***  ***  ***  ***  ***  ***  008  006
  ***  ***  ***  ***  ***  ***  005  004
  ***  ***  ***  ***  ***  ***  006  015
  ***  ***  ***  ***  ***  ***  ***  ***
  ***  ***  ***  ***  ***  ***  ***  ***
COMMAND? 1
COURSE (1-8.9)? 7
WARP (0-12)? 2
**SPOCK USED A NEW REPAIR TECHNIQUE**
LONG RANGE SENSORS ARE FIXED!
. * . . * . . .  YEARS = 94.0003
. . . . * . . .  STARDATE= 3481
* * . . * . . .  CONDITION: GREEN
. . . . . . . .  QUADRANT= 5 - 1
. . . . . . * .  SECTOR = 8 - 2
. * . . . . . .  ENERGY= 160
. . . . . . . .  [illegible]
. . . . . . . .  [illegible]  KLINGONS LEFT= 1
COMMAND? 3
LONG RANGE SENSORS FOR QUADRANT 7 - 8
   006   015   ***
   008   017   ***
   103   008   ***
COMMAND? 1
COURSE (1-8.9)? 6
WARP (0-12)? 1.4
 6.37485 UNIT HIT ON ENTERPRISE FROM SECTOR 4 - 4  ( 1410.82 LEFT)
. . . . . . . .  YEARS = 82.0003
. * . . . . . .  STARDATE= 3493
* . . . . . . .  CONDITION: RED
. . . K . . . .  QUADRANT= 8 - 7
. E * . . . . .  SECTOR = 5 - 2
. . . . . . . .  ENERGY= 1410.82
. . . . . . . .  PHOTON TORPEDOES= 8
. . . . . . . .  KLINGONS LEFT= 1
COMMAND? 5
TORPEDO COURSE (1-8.9)? 1.5
TRACK: 5 - 3
STAR DESTROYED!
 39.6225 UNIT HIT ON ENTERPRISE FROM SECTOR 4 - 4  ( 1371.2 LEFT)
COMMAND? 5
TORPEDO COURSE (1-8.9)? 1.5
TRACK: 5 - 3   4 - 4
KLINGON DESTROYED!

IT IS STARDATE 3493
THE FEDERATION HAS BEEN SAVED!
YOU ARE PROMOTED TO ADMIRAL
 17 KLINGONS IN 18.0003 YEARS.  RATING= 944
TRY AGAIN?
```

Now look through the printout to see exactly how the commands in Startrek are used. The game is a fairly easy one, since the ENERGY was initially set to 5000, and you have 100 years in which to accomplish your mission. Once you've mastered the game under these conditions, make it a bit more challenging by changing the program.

To change the number of years that you have, make T9 in line 120 of the program equal to 3475 plus the number of years you want. Notice that T9 = 3575, which equals 3475 plus 100, which gives 100 years to accomplish the mission. To give 30 years to accomplish the mission make T9 = 3505.

To change the amount of ENERGY with which the mission is begun, change E0 = 5000, in line 140. Make E0 equal to whatever you wish. Values of 4000 or 3500 are recommended.

Having read through this training course, you are a fully trained starship captain. Now get out there and make the Galaxy safe for humanity.

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Let me get the best . . . Please send the following

- ☐ 8 KSC 500ns ☐ KIT $295.00 ☐ ASSMB'LD $349.00
- ☐ 8 KSC-Z 250ns ☐ KIT $295.00 ☐ ASSMB'LD $349.00
- ☐ WWC ☐ KIT $37.50 ☐ ASSMB'LD $47.50
- ☐ BBUC ☐ KIT $55.00 ☐ ASSMB'LD $68.00
- ☐ EXT Extender card $29.00
- ☐ 100 pin edge conn ☐ ALTAIR® $9.00 ☐ IMSAI® $9.00
- ☐ ASSEMBLY & OPERATING MANUAL $4.00

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CITY _____ STATE _____ ZIP _____

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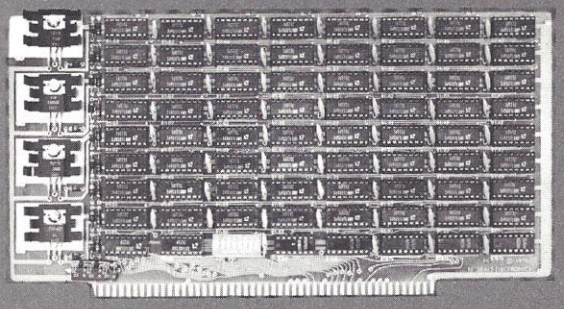


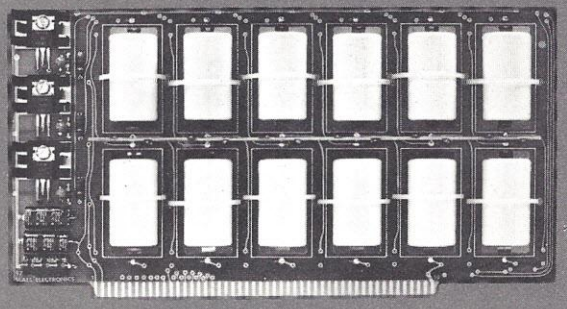
8 KSC [8K STATIC MEMORY BOARD]

Our most popular item. Hundreds of satisfied customers. We have received an enormous number of letters praising our 8 KSC board. Our 8 KSC is undoubtedly the highest quality and most dependable board on the market today.

INTRODUCTORY OFFER

We are proud to announce that you can order your 8 KSC-Z with 250ns memory at the same-yes SAME-price as our 500ns memory.

		KIT	ASSEMBLED
8 KSC	500ns	$295.00	$349.00
8 KSC-Z	250ns	$295.00	$349.00
EXT extender card		$ 29.00	$ 38.00
100 pin edge conn. [Altair®]			$9.00
100 pin edge conn. [IMSAI®]			$9.00
Assembly & Operating Manual			$4.00



BATTERIES NOT INCLUDED

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- Automatic battery charging circuit
- Selectable standby voltage outputs
- Will hold up to 12 "C" cell Ni-cad batteries. As much as 12 Amper hrs
- The BBUC comes selected for 2.5 volts standby to pin #14 on the S-100 buss structure, to power up the 8 KSC memory
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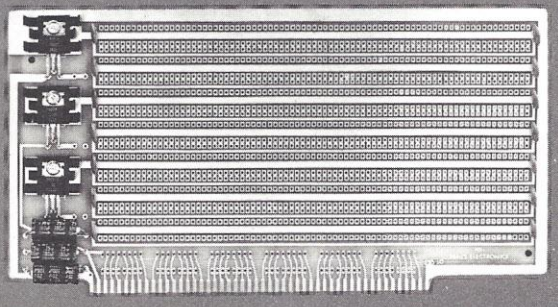
- Eliminate cluge wires on top of memory
- **Heavy G-10 glass epoxy PC board**
- **Heavy plated through holes-.5 mil. tin minimum**
- **Solder mask both sides**
- **Component layout screened on component side of PC board**

KIT - $55.00 ASSEMBLED - $68.00 ASSEMBLY & OPERATING MANUAL - $ 4.00



WWC [WIRE WRAP CARD]

- Accepts **ALL** IC wire wrap sockets 40, 22, 16, 14, etc.
- 3 voltage regulators: +12v, -12v, +5v
- 3 separate input capacitors 100 ufd
- 14 .1 ufd decoupling capacitors

- Gold plated edge contacts
- **Heavy G-10 glass epoxy PC board**
- **Heavy plated through holes -.5 mil. tin minimum**
- **Component layout screened on component side of PC board**

KIT	ASSEMBLED
$37.50	$47.50

SEALS® ELECTRONICS, INC.

TELEPHONE # 615/693-8655

CIRCLE 30

STORES

The approximately 170 stores listed here represent the best available information as of January 1977, when the list was typeset. Almost surely, there are a few errors and omissions for which we apologize, but we hope this gives you a feel for the scope of the new computer retailing field and that the listing will prove useful.

ARKANSAS

COMPUTER PRODUCTS UNLIMITED
2412 South Broadway
Little Rock, 72204

WESTARK COMPUTER SYSTEMS INC.
2803 Rogers
Fort Smith, 72901

ARIZONA

ALTAIR COMPUTER CENTER
4941 East 29th St.
Tucson, 85711

ANCRONA CORP.
4518 East Broadway
Tucson, 85711

BITS & BYTES COMPUTER SHOP
6819 C North 21st Ave.
Phoenix, 85015

BYTE PHOENIX
813 N. Scotsdale Rd.
Tempe, 85282

CALIFORNIA

A-VID ELECTRONICS CO.
1655 East 28th St.
Long Beach, 90806

ACTION AUDIO ELECTRONICS
285 Lake Merced Blvd.
Daly City, 94015

ANCRONA CORP.
Box 2208—P
Culver City, 90230

ANCRONA CORP.
11080 Jefferson Blvd.
Culver City, 90230

ANCRONA CORP.
1300 D East Edinger Ave.
Santa Anna, 92705

APPLIED COMPUTER TECHNOLOGY
2465 Fourth St.
Berkeley, 94610

BARGAIN ELECTRONICS ENTERPRISES
2018 Lomita Blvd., No. 1
Lomita, 90717

BITS, BYTES & PIECES
6211 Quincewood Circle
Citrus Heights, 95710

BITS N' BYTES
679 D. S. State College Blvd.
Fullerton, 92631

BYTE CITRUS HEIGHTS
6041 Greenback Lane
Citrus Heights, 95610

BYTE LAWNDALE
16508 Hawthorne Blvd.
Lawndale, 90260

BYTE PASADENA
496 S. Lake Ave.
Pasadena, 91101

BYTE SAN DIEGO
5375 Kearny Villa Rd.
San Diego

BYTE SAN FERNANDO VALLEY
18424 Ventura Blvd.
Tarzana, 91356

BYTE SAN MATEO
1200 W. Hillsdale Blvd.
San Mateo, 74403

BYTE SANTA BARBARA
3 West Mission St.
Santa Barbara, 93101

BYTE SHOP
1514 University Ave.
Berkeley, 94703

BYTE SHOP
2559 S. Bascom Ave.
Campbell

BYTE SHOP
1063 W. El Camino Real
Mountain View

BYTE SHOP
1225 Ocean St.
Santa Cruz

BYTE SHOP
2989 North Main St.
Walnut Creek, 94596

BYTE SHOP OF PALO ALTO
2227 El Camino Real
Palo Alto, 94306

BYTE SHOP OF SAN FRANCISCO
1093 Mission St.
San Francisco, 94306

BYTE SHOP OF SAN JOSE
155 Blossom Hill Rd.
San Jose, 95123

BYTE SHOP OF SAN RAFAEL
509 Francisco Blvd.
San Rafael, 94901

BYTE SHOP OF SANTA CLARA
3400 El Camino Real
Santa Clara, 95050

BYTE THOUSAND OAKS
2705 Thousand Oaks Blvd.
Thousand Oaks, 91360

BYTE WESTCHESTER
8711 La Tiera Ave.
Westchester, 90045

BYTE WESTMINISTER
14300 Beach Blvd.
Westminister, 92683

CHANNEL RADIO & ELECTRONICS
18 East Ortega St.
Santa Barbara, 93101

COMPUTER CENTER
8205 Ronson Rd.
San Diego, 92111

COMPUTER COMPONENTS
5848 Sepulveda Blvd.
Van Nuys, 91411

COMPUTER KITS
1044 University Ave.
Berkeley, 94710

COMPUTER MART
625 W. Katella #10
Orange, 92667

COMPUTER POWER & LIGHT INC.
12321 Ventura Blvd.
Studio City, 91604

COMPUTER SHACK
22634 Foothill Blvd.
Hayward, 94541

COMPUTER SHACK
Headquarters
14860 Wicks Blvd.
San Leandro, 94577

COMPUTER STORE
820 Broadway
Santa Monica, 90401

COMPUTER STORE OF SAN FRANCISCO
1093 Mission St.
San Francisco, 94103

COMPUTER SYSTEMS UNLIMITED
18886 Hesperian Blvd.
San Lorenzo

COMPUTER WAY INC.
15525 Computer Lane
Huntington Beach, 92649

COMPUTERS & STUFF
664 Via Alamo
San Lorenzo, 94580

COMPUTERWARE
830 First St.
Encinitas, 92024

COYOTE COMPUTER
1405 Alder Place
Davis, 95616

CTI DATA SYSTEMS
3450 East Spring St.
Long Beach, 90806

CYBERDUX
Microcomputer Applications
1210 Santa Fe Drive
Encinitas, 92024

DATA CENTER
136 N. Maryland Ave.
Glendale, 91206

ELECTRIC BRAIN COMPUTER STORE
700 Village Parkway Suite L
Dublin, 94566

ELECTRONICS WAREHOUSE INC.
1603 Aviation Blvd.
Redondo Beach, 90278

KENTUCKY FRIED COMPUTERS
2465 Fourth St.
Berkeley, 94710

MICRO BYTE
183 E. 8th
Chico, 95926

MICRO BYTE
584 Rio Linda Suite 4
Chico, 95926

PEOPLE'S COMPUTER SHOP
13452 Ventura Blvd.
Sherman Oaks, 91423

RAINBOW ENTERPRISES
10723 White Oak Ave.
Granada Hills, 91344

SMALL BUSINESS COMPUTER CO.
400 Dewey Blvd.
San Francisco, 94116

SUNNY TRADING CO.
2530 W. Sepulveda Blvd.
Torrance, 90505

SUNNYSOUNDS
927 E. Las Tunas Drive
San Gabriel, 91776

SUNSHINE COMPUTER CO.
9 Palomino Lane
Carson, 90745

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BYTE COLORADO
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Englewood, 80110

COMPUTER COUNTRY
18 Alameda Square
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Denver

GATEWAY ELECTRONICS
2839 W. 44th Ave.
Denver, 80211

INTERMOUNTAIN DIGITAL
1027 Dellwood Ave.
Boulder, 80302

CONNECTICUT

COMPUTER STORE INC.
63 South Main St.
Windsor Locks, 06096

HEURISTIC SYSTEMS
244 Crystal Lake Rd.
Ellington, 06029

JRV COMPUTER STORE
3714 Whitney Ave.
Hamden, 06518

DELAWARE

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1203 Flint Hill Rd.
Wilmington, 19808

FLORIDA

COMPUTER ASSOCIATES INC.
6900 N. Kendall Drive, Suite A103
Miami, 33156

COMPUTER MART OF FLORIDA
4981 72nd Avenue N
Pinellas Park, 33565

COMPUTER STORE
c/o Comprehensive Systems
Box 21
Pensacola, 32502

DOUGLAS COMPUTER SYSTEMS
710 Oaks Plantation Drive
Jacksonville, 32211

ELECTRONICS FOR YACHTING
2001 S.W. 20th St.
Ft. Lauderdale, 33315

MARSH DATA SYSTEMS
5405-B Southern Comford Blvd.
Tampa, 33614

MICRO COMPUTER SYSTEM SALES & SERVICE
Box 4489
Pompano Beach, 33606

MICROCOMPUTER SYSTEMS INC.
144 South Dale Mabry Highway
Tampa, 33609

SUNNY COMPUTER STORES INC.
117 Newton Rd.
West Hollywood, 33023

GEORGIA

ALTAIR SOFTWARE DISTRIBUTION CENTER
3330 Peachtree, N.E., Suite 343
Atlanta, 30305

ATLANTA COMPUTER MART
5091-B Buford Highway
Atlanta, 30340

COMPUTER SYSTEMCENTER
3330 Piedmont Road N.E.
Atlanta, 30305

ILLINOIS

AMERICAN MICROPROCESSORS
241 Indian Creek Rd.
Prairie View, 60069

STORES

CHICAGO COMPUTER STORE
517 Talcott Rd.
Park Ridge, 60068

DATA DOMAIN
42 W. Roosevelt
Lombard, 60148

ITTY-BITTY MACHINE CO.
1318 Chicago Ave.
Evanston, 60201

INDIANA

DATA DOMAIN
111 South College Ave.
Bloomington, 47401

DATA DOMAIN
7027 Michigan Rd.
Indianapolis, 46268

HOBBYTRONIC DISTRIBUTORS
1218 Prairie Drive
Bloomington, 47401

QUANTUM COMPUTER WORKS
6637 Kennedy Ave.
Hammond, 46323

KANSAS

COMPUTER HUT
21 N. Hillside
Wichita, 67214

COMPUTER LAND
1262 N. Hillside
Wichita, 67214

MIDWEST SCIENTIFIC INSTRUMENTS INC.
220 W. Cedar
Olathe, 66061

KENTUCKY

CYBERTRONICS
312 Production Court
Louisville, 40299

DATA DOMAIN
506½ Euclid Ave.
Lexington, 40502

DATA DOMAIN
3028 Hunsinger Lane
Louisville, 40220

LOGIC SYSTEMS
324 W. Woodlawn Ave.
Louisville, 40214

LOUISIANA

EXECUTONE MICROCOMPUTER
6969 Titian Ave.
Baton Rouge, 70806

MARYLAND

COMPUTER WORKSHOP
11308 Hounds Way
Rockville, 20852

COMPUTER WORKSHOP
5709 Frederick Ave.
Rockville, 20852

MASSACHUSETTS

AMERICAN USED COMPUTER
712 Beacon St.
Boston, 02215

AMERICAN USED COMPUTER WAREHOUSE STORE
584 Commonwealth Ave.
Boston, 02215

CENTRAL CONCEPTS
Box 272
Needham Heights, 02194

COMPUTER MART
473 Winter St.
Waltham, 02154

COMPUTER STORE INC.
120 Cambridge
Burlington, 01803

MICHIGAN

COMPUMART INC.
254 South Wagner Rd.
Ann Arbor, 48103

COMPUTER STORE OF ANN ARBOR
310 East Washington St.
Ann Arbor, 48104

MINNESOTA

BYTE MINNESOTA INC.
1434 Yankee Doodle Rd.
Eagan, 55121

COMPUTER ROOM
3938 Beau D'Rue Drive
Eagan, 55122

MISSOURI

COMPUTER WORKSHOP INC. OF KANSAS CITY
6903 Blair Rd.
Kansas City, 64152

GATEWAY ELECTRONICS
8123-25 Page Blvd.
St. Louis, 63130

MONTANA

MONTANA COMPUTER CENTER
2512 Grande Ave.
Billings, 59102

NEBRASKA

ALTAIR COMPUTER CENTER
2801 Cornhusker Highway
Lincoln, 68504

WELLING ELECTRONICS
529 North 33rd St.
Omaha, 68131

NEW HAMPSHIRE

MICRO COMPUTERS INC.
539 Amherst St.
Nashua, 03060

NEW JERSEY

COMPUTER MART OF NEW JERSEY
151 Kline Blvd.
Colonia, 07067

COMPUTER ROOM
451 Simons Ave.
Hackensack 07601

HOBOKEN COMPUTER WORKS
20 Hudson Place
Hoboken, 07030

MIDWEST ENTERPRISES INC.
815 Standish Ave.
Westfield, 07090

WILLIAM ELECTRONICS SUPPLY
1863 Woodbridge Ave.
Edison, 08817

NEW MEXICO

COMPUTER SHACK
3120 San Mateo N.E.
Albuquerque, 87110

NEW YORK

BYTE LONG ISLAND N.Y.
2721 Hempstead Turnpike
Levittown, 11756

COMPUT-O-MAT SYSTEMS
41 Colby Ave.
Rye, 10580

COMPUTER CORNER
200 Hamilton Ave.
White Plains, 10013

COMPUTER MART OF LONG ISLAND INC.
2072 Front St.
East Meadow, 11554

COMPUTER MART OF NEW YORK
314 Fifth Ave.
New York, 10001

COMPUTER MICROSYSTEMS
6 Wooleys Lane
Great Neck, 11023

COMPUTER STORE
269 Osborne Rd.
Albany, 12211

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We're interested in publishing short science fiction articles with mini-computer central themes. Payment (consistent with length and quality) made upon acceptance. Must be original and not elsewhere published. Submit articles with self-addressed stamped envelope to **Personal Computing**, 401 Louisiana SE No. G, Albuquerque, NM 87108.

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COMPUTER STORE OF NEW YORK
55 West 39th St.
New York, 10018

MJB RESEARCH & DEVELOPMENT
36 West 62nd St.
New York, 10023

SYNCHRO SOUND ENTERPRISES
193-25 Jamaica Ave.
Hollis, 11423

WACO TRADING CO.
239 Park Ave. South
New York, 10003

OHIO

ELS SYSTEMS
2209 N. Taylor Rd.
Cleveland,Heights, 44112

RIDGEWAY EAST
Retail Computer Center
161 Bell St.
Chagrin Falls, 44022

WINTERRADIO ELECTRONIC SUPPLY CORP
1468 West 25th St.
Cleveland, 44113

OKLAHOMA

GLOBAL ENGINEERING CO.
5416 South Yale
Tulsa, 74145

HIGH TECHNOLOGY
1020 West Wilshire Blvd.
Oklahoma City, 74116

OREGON

ALTAIR COMPUTER CENTER
8105 S.W. Nimbus Ave.
Beaverton, 97005

BYTE SHOP OF PORTLAND
2033 S.W. 4th
Portland, 97201

REAL OREGON COMPUTER CO.
205 West 10th Ave.
Eugene, 97401

PENNSYLVANIA

ARTCO ELECTRONICS
302 Wyoming Ave.
Kingston, 18704

BYTE PHILADELPHIA
1045 W. Lancaster Ave.
Bryn Mawr, 19010

CALDWELL COMPUTER CO.
546 West Olney Ave.
Philadelphia, 19120

COMPUTER ROOM
S.E. Corner Juniper & Sansome Streets
Philadelphia, 19103

COMPUTER ROOM
c/o Carol Groves Castle Systems
1028 Spruce St.
Philadelphia, 19107

J. B. INDUSTRIES
610 W. Olney Ave.
Philadelphia, 19120

MARTIN J. O'BOYLE & ASSOC.
Box 9094
Pittsburgh, 15224

PERSONAL COMPUTER CORP.
Frazer Mall
Frazer, 19355

RHODE ISLAND

COMPUTER POWER INC.
M24 Airport Mall
1800 Post Rd.
Warwick, 02886

TENNESSEE

BYTE 'TRONICS
5604 Kingston Pike
Knoxville, 37919

BYTE 'TRONICS
Suite 103, 1600 Hayes St.
Nashville, 37203

TEXAS

ALTAIR COMPUTER CENTER
12902 Harwin
Houston, 77072

BIT BARN
1111 Burke No. 313
Pasadena, 77506

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STORES

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Dallas, 75207

MICRO STORE
634 S. Central Expressway
Richardson, 75080

POLARIS COMPUTER SYSTEMS
3311 Richmond Station 200
Houston, 77006

RONDURE CO.
2522 Butler St.
Dallas, 75237

UTAH

COMPUTER ROOM
1455 South 1100 East
Salt Lake City, 84105

COMPUTERS & STUFF
1092 S. State St.
Orem, 84057

VIRGINIA

ALTAIR COMPUTER CENTER
Computers-to-go
6223 West Broad St. Rd.
Richmond, 23230

COMPUTER HOBBIES UNLIMITED
9601 Kendrick Rd.
Richmond, 23235

MICROSYSTEMS
6605A Blacklick Rd.
Springfield,

WASHINGTON

ALMAC-STROUM
5811 Sixth Ave. South
Seattle, 98108

MICROCOMPUTER APPLICATIONS
6009-B 13th Way S.E.
Olympia, 98503

RETAILER COMPUTER STORE
410 N.E. 72nd
Seattle, 98115

WEST VIRGINIA

COMPUTER STORE
1114 Charleston National Plaza
Charleston, 25301

WISCONSIN

ITTY BITTY MACHINE CO.
2221 East Capitol Drive
Shorewood

MILWAUKEE COMPUTER STORE
6916 West North Ave.
Milwaukee, 53213

Since so many computer stores continue to open, we'd appreciate your help in keeping our list up-to-date. Eventually we hope to print another list when warranted. Please send names and addresses of new stores to our editorial offices.

Personal Computing

RATES

Individual: $1 per word; address set free; first two words set in all capital letters for free. If you want **bold** type, add $1 for each word set bold. Add $5 if you want replies sent to us and forwarded to you.

Company: 1X: $60/inch; 3X: $55/inch; 6X: $50/inch. Display ads accepted only if camera-ready materials submitted. Agency commission paid on camera-ready ads and after the first insertion of a publisher-set ad if subsequent insertions run without changes. Publisher sets ads as in format and attempts to fit copy into space requested.

Advertisement accepted, however, with understanding that space may be larger than requested. Minimum billing size one inch; ads billed in half-inch increments thereafter. Frequency rate applies to publisher-set ads only if they run without changes in subsequent issues.

To place an ad, send your copy to Classified Ad Dept., **Personal Computing,** *167 Corey Rd., Brookline, MA 02146.*

CLASSIFIED

DEADLINES

Publisher set:	First of the month two months before issue date.
Camera-ready:	Fifth of the month two months before issue date.

STAFF EDITOR WANTED for PERSONAL COMPUTING, the consumer magazine for the recreational computer market. As a member of the editorial staff you'll procure original articles on hardware and software as well as edit staff-written and contributed manuscripts — and occasionally write one of your own. You must have a thorough knowledge of computer hardware and software. Journalism experience will be helpful. Send replies in confidence to: H.G. Buchbinder, Editorial Director, Personal Computing, 167 Corey Road, Brookline, MA 02146.

Personal Computing

ADVERTISERS' INDEX

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Northeast: Irwin Stern, 167 Corey Rd., Brookline, MA 02146; (617) 232-5470 • **Mid-Atlantic:** Robert Poggi, 69 So. Central Ave., Valley Stream, NY 11580; (516) 872-9550 • **Mid-West:** Ralph Petersen, 1 Wheaton Ctr. No. 1706, Wheaton, IL 60187; (312) 653-2480 • **Southwest:** David Bunnell, 401 Louisiana, S.E. No. G, Albuquerque, NM 87108; (505) 266-1173 • **West:** Yuri Spiro & Carol Stagg, 823 Enchanted Way, Pacific Palisades, CA 90272; (213) 454-0624

If you're moving...

Please allow at least six weeks for us to put your new address into our subscription computer. Send your new address and the mailing label with your old address to: Circulation Dept., Personal Computing, 167 Corey Rd., Brookline, MA 02146.

Or use this convenient form.

Please attach here the mailing label with your old address

Write in here your new address.

NAME _____

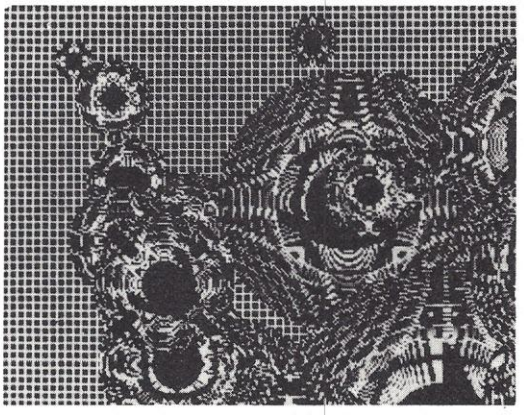
ADDRESS _____

CITY _____ STATE _____ ZIP _____

Featured Artist

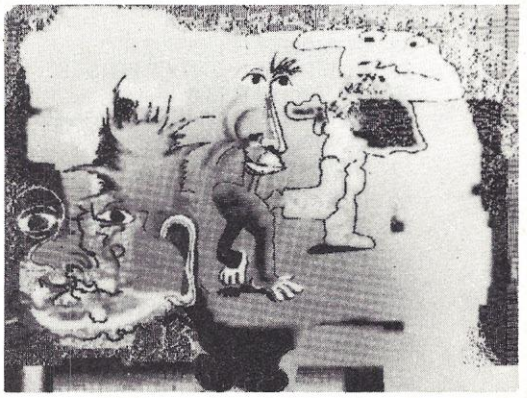
Duane Michael Palyka is distinguished among "computer artists" for his diligence in pressing beyond the conventional "wire cage" figures that have been the common product of the field. His richly colored "solid figures" range from handsome abstractions through dramatic portraits to entertaining cartoons. The style of his work is not simply forced on him by the limitations of the computer system's unique characteristics as a drawing and painting instrument.

Palyka comments that it's difficult to maintain the "poor, starving artist" image and outlook while working with a $300,000 instrument. Obviously, it's necessary for him to work within some institution that can support the equipment necessary to him and his justification for the expenditures must be persuasive. In fact, he has pioneered both in technology and art, creating both images and a body of information that will be useful and rewarding for others in the decades to come. (Palyka's *vita* points out that he is thus far the only student to receive Bachelor's Degrees in both Mathematics and Art from Carnegie-Mellon University.)



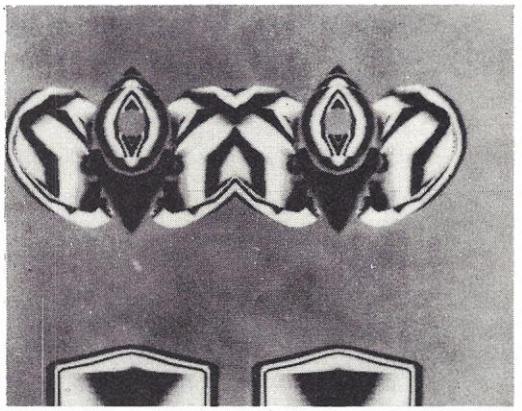
"Patterned Spheres"

The artist frets that his work can be displayed and published only via color photographs and halftone printing, neither of which can capture the brilliance and excitement of the "original" images that are painted with light on the face of a color CRT. It is possible to recreate "original" images by driving a CRT from a tape on which the data are recorded, but in the ordinary world, systems that can handle such displays are few. Even the photo and press reproductions are so striking that Palyka's work has been widely published and exhibited at shows around the world. His list of exhibition credits, not only for computer-generated work but for paintings and prints, is very impressive, running to several pages. Palyka's influence in the new field of computer art will surely be appreciable.



"Strange Bird"

The black and white images on this page are a modest sampling of his computer work. The extraordinary color work on our back-cover gatefold demonstrates the control of his new medium that Palyka has achieved.



"Spaced Ears"

Incidentally, the color spectrum displayed on this page is normally at the bottom of the image and serves as the "pallette" from which the artist selects his colors.

See SWTPC computer equipment at your local dealer

ARIZONA
Byte Shop of Arizona
813 N. Scottsdale Rd.
Temple, Az. 85282

ARKANSAS
Westark Computer Systems, Inc.
2803 Rogers Ave.
Fort Smith, Ark. 72901

CALIFORNIA
Byte Shop of Berkeley
1514 University Ave.
Berkeley, Ca. 94703

Sunshine Computer Co.
9 Palomino Lane
Carson, Calif. 90745

The Electric Brain Computer Store
700 Village Parkway, Suite L
Dublin, Ca. 94566

Computerware
830 First St.
Encinitas, Ca. 92024

Cyberdux
Microcomputer Applications
1210 Santa Fe Dr.
Encinitas, Ca. 92024

A-VID Electronics Co.
1655 East 28th St.
Long Beach, Ca. 90806

The Byte Shop Computer Store #1
1063 El Camino Real
Mountain View, Ca. 94040

Byte Shop of Palo Alto
2227 El Camino
Palo Alto, Ca. 94306

The Computer Center
8205 Ronson Rd.
San Diego, Ca. 92111

Computer Shack
14860 Wicks Blvd.
San Leandro, Ca. 94577

Computer Store of San Francisco
1093 Mission St.
San Francisco, Ca. 94103

Byte Shop
155 Blossom Hill Rd.
San Jose, Ca. 95123

The Byte Shop Computer Store #2
3400 El Camino Real
Santa Clara, Ca. 95051

The Computer Store
820 Broadway
Santa Monica, Ca. 90401

CONNECTICUTT
JRV Computer Store
3714 Whitney Ave.
Hamden, Conn. 06518

FLORIDA
Sunny Computer Stores, Inc.
University Shopping Center
1238 A South Dixie Hwy.
Coral Gables, Fla. 33146

Electronics for Yachting, Inc.
1525 S.E. 16th St.
Ft. Lauderdale, Fl. 33315

Douglas Computer System
Jacksonville, Fl.

Computer Assoc., Inc.
6900 N. Kendall Dr., Suite A103
Miami, Fl. 33156

Microcomputer Systems, Inc.
144 S. Dale Mabry Ave.
Tampa, Fl. 33609

GEORGIA
Atlanta Computer Mart
5091-B Buford Highway
Atlanta, Ga. 30340

ILLINOIS
Semiconductor Specialists
MPV Shop
195 Spangler Ave.
Elmhurst, Ill. 60126

American Microprocessors
Equipment & Supply Corp.
20 N. Milwaukee
Prairie View, Il. 60069

Litlipute Computer Mart, Inc.
4446 Oakton St.
Skokie, Ill. 60076

INDIANA
Data Domain
111 S. College Ave.
Bloomington, In. 47401

Computer Specialties
107 N. Chauncey
W. Lafayette, In. 47906

Syscon International, Inc.
1239 South Bend Ave.
South Bend, In. 46617

KANSAS
Midwest Scientific Instruments, Inc.
220 W. Cedar
Olathe, Ks. 66061

Computer Hut
521 N. Hillside
Wichita, Kansas

KENTUCKY
Cybertronics
312 Production Ct.
Louisville, Ky. 40299

LOUISIANA
Baxter's T.V.
7964 Jefferson Hwy.
Baton Rouge, La. 70809

MARYLAND
The Computer Workshop, Inc.
5709 Fredrick Ave.
Rockville, Md. 20852

MASSACHUSETTS
Computer Warehouse Store
584 Commonwealth Ave.
Boston, Ma. 02215

Computer Mart of Massachusetts
1087 Lexington St.
Waltham, Ma. 02154

MICHIGAN
Mini-Mac, Inc.
303 S. Lemen
Fenton, Mich 48430

MONTANA
Montana Computer Co.
2512 Grand Ave.
Billings, Montana 59102

MINNESOTA
Landers Electric, Inc.
626 S. Holcombe
Litchfield, Minn. 55355

MISSOURI
Computer Workshop of Kansas City
6903 Blair Rd.
Kansas City, Mo. 64152

NEVADA
Johnson T.V. Micro-Computer
2607 E. Charleston
Las Vegas, Nv. 98110

NEW JERSEY
William Electronics Supply
1863 Woodbridge Ave.
Edison, N.J. 08817

Midwest Enterprises, Inc.
815 Standish Ave.
Westfield, N.J. 07090

NEW YORK
Computers Plus
7 Westchester Plaza
Elmsford, N.Y. 10523

Audio Design Electronics
487 Broadway, Room 512
New York, N.Y. 10013

Computer Mart of New York, Inc.
314 Fifth Ave.
New York, N.Y. 10001

OHIO
ELS Systems
2209 N. Taylor Rd.
Cleveland Heights, Oh. 44112

OKLAHOMA
High Technology
1020 Wilshire Blvd.
Oklahoma City, Okla. 73114

OREGON
Byte Shop
2033 S.W. 4th Ave.
Portland, Ore. 97201

PENNSYLVANIA
Martin J. O'Boyle & Assoc.
P.O. Box 9094
Pittsburgh, Pa. 15224

UTAH
The Computer Room
1455 South 1100 East
Salt Lake City, Ut. 84105

TEXAS
Microtex, Inc.
9305-D Harwin Dr.
Houston, Tx. 77036

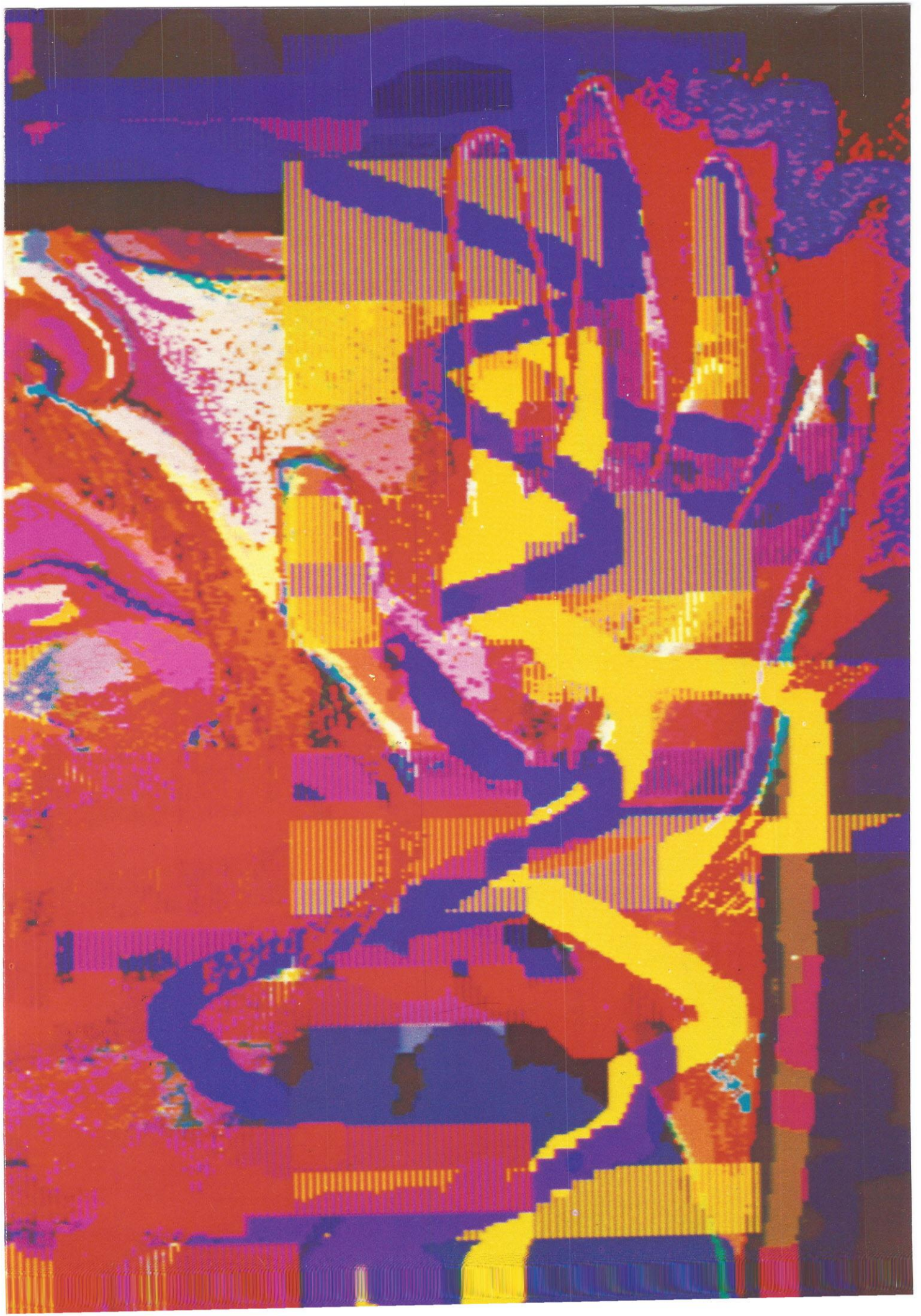
Electronic Module of Odessa
606 West 10th St.
Odessa, Tx. 79763

The Micro Store
634 S. Central Expressway
Richardson, Tx. 75080

WASHINGTON
The Retail Computer Store
410 N.E. 72nd St.
Seattle, Wa. 98115

WISCONSIN
The Milwaukee Computer Store
6916 W. North Ave.
Milwaukee, Wi. 53213

WYOMING
Computer Radio Workshop
120 El Dorado Ct.
Cheyenne, Wy. 82001



"Reaching Out" by Duane Michael Palyka
Personal Computing Magazine March/April 1977

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